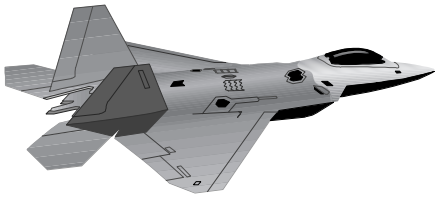
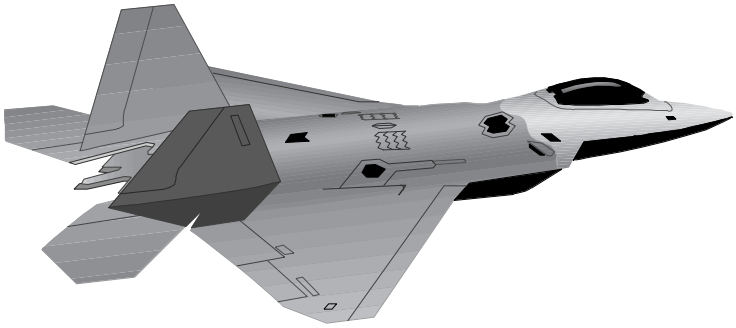
DRAFT FINAL
ENVIRONMENTAL ASSESSMENT
September 2001





F-22 INITIAL OPERATIONAL TEST AND EVALUATION

DRAFT FINAL

FINDING OF NO SIGNIFICANT IMPACT (FONSI)
FOR THE F-22 INITIAL OPERATIONAL TEST AND EVALUATION

The attached environmental assessment (EA) analyzes the potential environmental impacts associated with implementation of the F-22 Initial Operational Test and Evaluation (IOT&E) phase activities, support aircraft operations and effects are addressed as part of the baseline activities. The Proposed Action would entail basing four F-22 aircraft at the existing F-22 Combined Test Force site at Edwards Air Force Base (AFB), and conducting training flights in the R-2508 Complex and High Altitude Supersonic Corridor (HASC) in California and the Nellis Range Complex (NRC) airspace in Nevada and Utah. F-22 IOT&E flight activities would occur during a 10- to 12-month period between 2002 and 2003. The No-Action Alternative would be not to conduct the F-22 IOT&E flight tests.

Aspects of socioeconomics, transportation, utilities, geology and soils, and water resources would not be affected by proposed activities. There would be no changes in existing land use at Edwards AFB. Land use beneath the airspace complexes would not be appreciably affected because there would be no changes in airspace usage. F-22 overflight and sonic booms would not result in a significant change in noise levels or sonic boom intensity or frequency. Airspace usage would remain below recent historic use levels and would occur within existing areas and use restrictions. Hazardous materials used and hazardous waste generated would be handled in accordance with established procedures; F-22 program requirements have been incorporated into the Hazardous Materials Distribution Support Center (HDSC) Operating Instruction and existing management programs at Edwards AFB. All F-22 program personnel will be trained in the use of the HDSC. Ordnance handling at Edwards AFB would occur within existing safety procedures, and chaff and flare usage on the NRC would occur within existing usage restrictions. Noise levels from F-22 ground operations at Edwards AFB would be similar to those currently generated in these areas. Noise levels from F-22 overflight and sonic boom intensities would be within the levels currently experienced in the overflight areas. F-22 overflights would not be expected to startle wildlife because these would occur at a minimum altitude of 3,000 feet above ground level, which is well above the 550-foot above-ground-level zone that has been shown to account for most wildlife reaction to visual stimuli. There would be no significant change to the noise environment that could affect wildlife. Cultural resources are also not expected to be significantly affected because noise vibration levels would not significantly change from existing levels experienced in overflight areas.

An analysis of other scheduled programs at Edwards AFB, the R-2508 Complex, and the HASC indicated that two programs were planned, the Joint Strike Fighter (ends before the F-22 IOT&E program starts) and the X-33 (cancelled), but did not reveal any other programs or activities having minor or major cumulative impacts. Activities associated with the F-22 Aircraft Force Development Evaluation and Weapons School Beddown at Nellis AFB would overlap with the F-22 IOT&E activities in the NRC. No minor or major cumulative impacts in the NRC were identified. Cumulative impacts arising from past and present projects or activities are, by their very nature, accounted for through the establishment of baselines portraying existing conditions. Environmental effects arising from future projects or activities that are projected to occur during the F-22 IOT&E program are also accounted for as cumulative impacts.

As a result of the analysis of impacts in the EA, it was concluded that the activities proposed to be conducted under the Proposed Action would not have a significant effect on human health or the natural environment. This FONSI is based upon the attached EA, which has been independently evaluated by the Air Force and determined to adequately and accurately discuss the need, environmental issues, and impacts of the proposed project. This EA provides sufficient evidence and analysis to determine that an environmental impact statement is not required.

Signed: _____

Date: _____

COVER SHEET
DRAFT FINAL ENVIRONMENTAL ASSESSMENT
F-22 INITIAL OPERATIONAL TEST AND EVALUATION

a. Responsible Agency: Department of the Air Force

b. Proposed Action: F-22 Initial Operational Test and Evaluation (IOT&E).

c. Written comments and inquiries regarding this document should be directed to: Jonathan D. Farthing, HQ AFCEE/ECA, 3207 North Road, Brooks Air Force Base (AFB), Texas 78235-5363, (210) 536-3787.

d. Report Designation: Draft Final Environmental Assessment (EA).

e. Abstract: The purpose of the Proposed Action is to test and evaluate the F-22 aircraft in as realistic an operational environment as possible to estimate the prospective system's military utility, operational effectiveness, and operational suitability. This EA analyzes the potential environmental impacts from basing four F-22 aircraft at Edwards AFB, conducting pilot training flights in R-2508 Complex airspace in California and the Nellis Range Complex (NRC) airspace in Nevada and Utah, and performing test flights in representative combat scenarios in NRC airspace. Operations would occur within existing airspace and airspace parameters. No construction or modification of facilities would occur. The No-Action Alternative would be not to conduct the IOT&E flight tests.

This EA analyzes the potential environmental impacts from proposed activities on land use, airspace, hazardous materials and waste management, air quality, noise, biological resources, and cultural resources. The Air Force has determined that the impacts to these resources would not be significant.

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1.0 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

This environmental assessment (EA) analyzes the potential environmental consequences of conducting the F-22 Initial Operational Test and Evaluation (IOT&E) program. The F-22 IOT&E activities analyzed would occur at the following locations: Edwards Air Force Base (AFB) in California; Nellis AFB in Nevada; the R-2508 Complex airspace in California; the High-Altitude Supersonic Corridor (HASC) in California and Nevada; and the Nellis Range Complex (NRC) airspace in Nevada and Utah (Figures 1-1, 1-2, and 1-3).

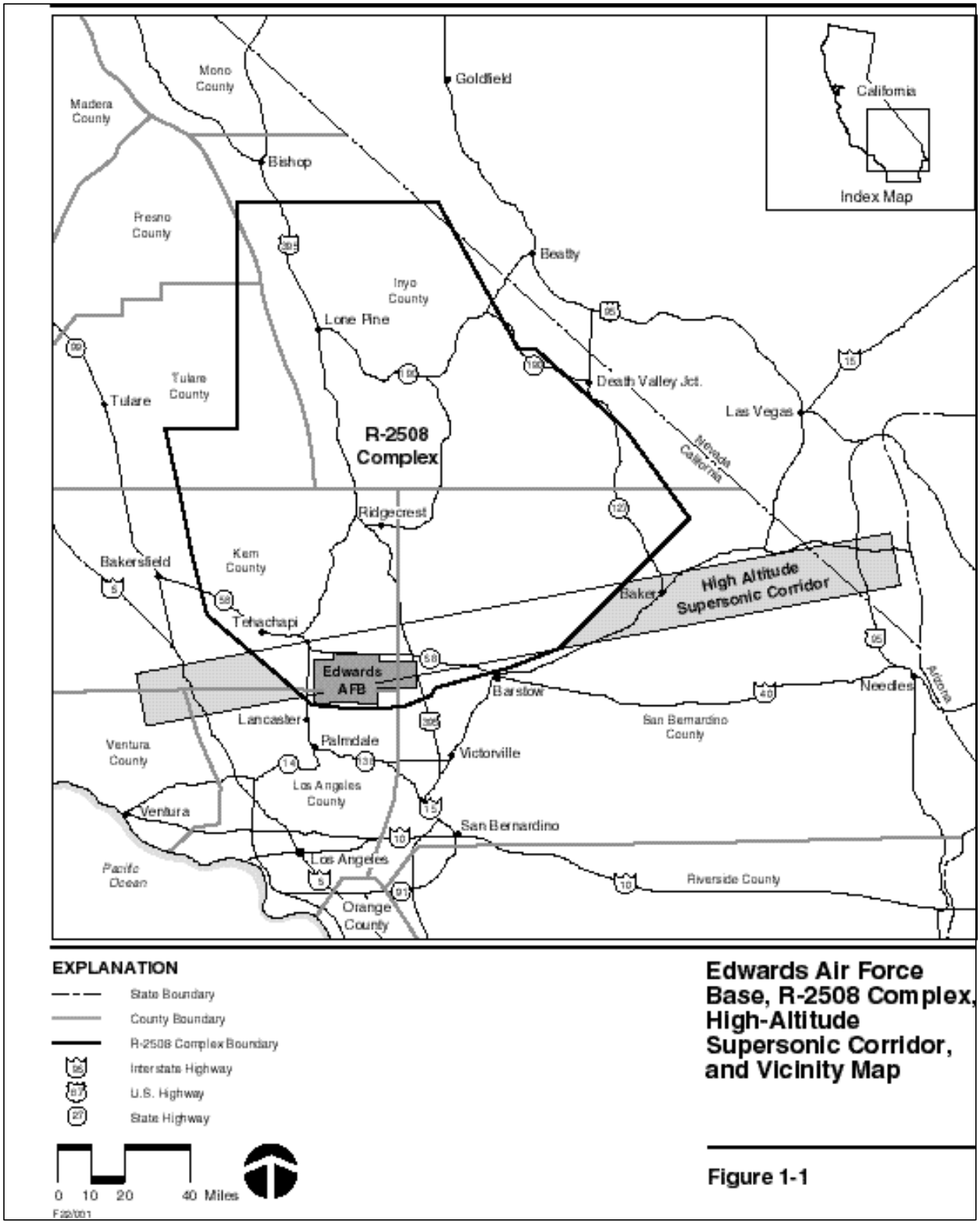
This document has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S. Code [U.S.C.] 4321 et seq.), the Council on Environmental Quality (CEQ) regulations implementing the procedural provisions of NEPA (40 Code of Federal Regulations [CFR] Parts 1500-1508), and Air Force policy and procedures (32 CFR Part 989).

1.1 BACKGROUND

The F-22 was chosen as a major Air Force acquisition program to provide air dominance with improved capability over current Air Force aircraft. It will be required to defeat the future threat presented by foreign-built aircraft employed by air forces worldwide. The F-22 is designed to provide a balance of stealth, supercruise, and integrated avionics to meet those threats. The F-22 would provide a clear advantage over future-generation, foreign-built fighters.

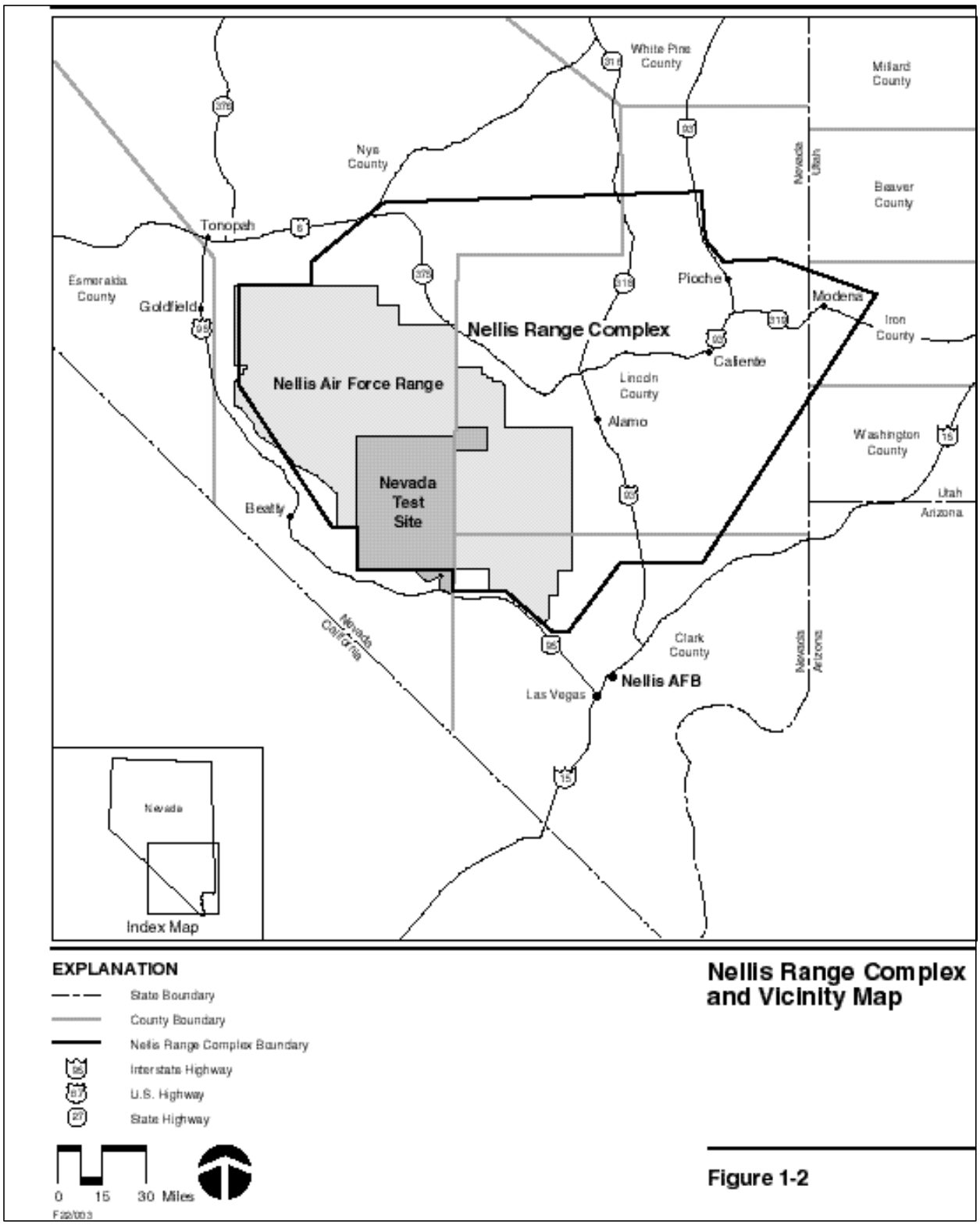
The requirement for the F-22 was identified through the process described in Air Force Instruction (AFI) 10-601, Mission Needs and Operational Requirements Document and Procedures. During the early 1980s, the Air Force assessed its tactical capabilities against projected threats and determined that a mission deficiency would exist in the near future that could jeopardize the ability of the United States to ensure that its forces have the freedom of action to conduct operations against opposing forces. The Advanced Tactical Fighter Statement of Operational Need (November 1984) detailed this need, and Congressional funding and approval were received in 1985. In October 1986, the Phase I Demonstration/Validation (Dem/Val) program was initiated, and the F-22's operational requirements, or Key Performance Parameters, were established. These parameters, which were documented in the System Operational Requirements document in 1987 and supported a Milestone I decision, were updated on March 1, 1991. During the same time, the Advanced Tactical Fighter Full-Scale Development Environmental Assessment (U.S. Air Force, 1991) was prepared. Full-Scale Development has been subsequently redesignated as Engineering and Manufacturing Development (EMD). The 1991 EA analysis resulted in a Finding of No Significant Impact (FONSI). The FONSI and the System Operational Requirements document were also validated by the Air Force and the Department of Defense (DOD) during the 1991 Advanced Tactical Fighter (ATF) Milestone II review. The FONSI was approved and signed by Brigadier

General Stephen E. Cranston, Vice Commander, Aeronautical Systems Division, in May 1991. Milestone II approval was confirmed by an Acquisition



Edwards Air Force Base, R-2508 Complex, High-Altitude Supersonic Corridor, and Vicinity Map

Figure 1-1


White Pine County
Millard County
Nye County
Nevada
Utah
Beaver County
Tonopah
Esmeralda County
Goldfield
Pioche
Modena
Iron County
Nellis Range Complex
Caliente
Nellis Air Force Range
Lincoln County
Alamo
Washington County
Nevada Test Site
Beatty
Utah
Arizona
Nevada
California
Clark County
Nevada
Arizona
Nellis AFB
Las Vegas
Nevada
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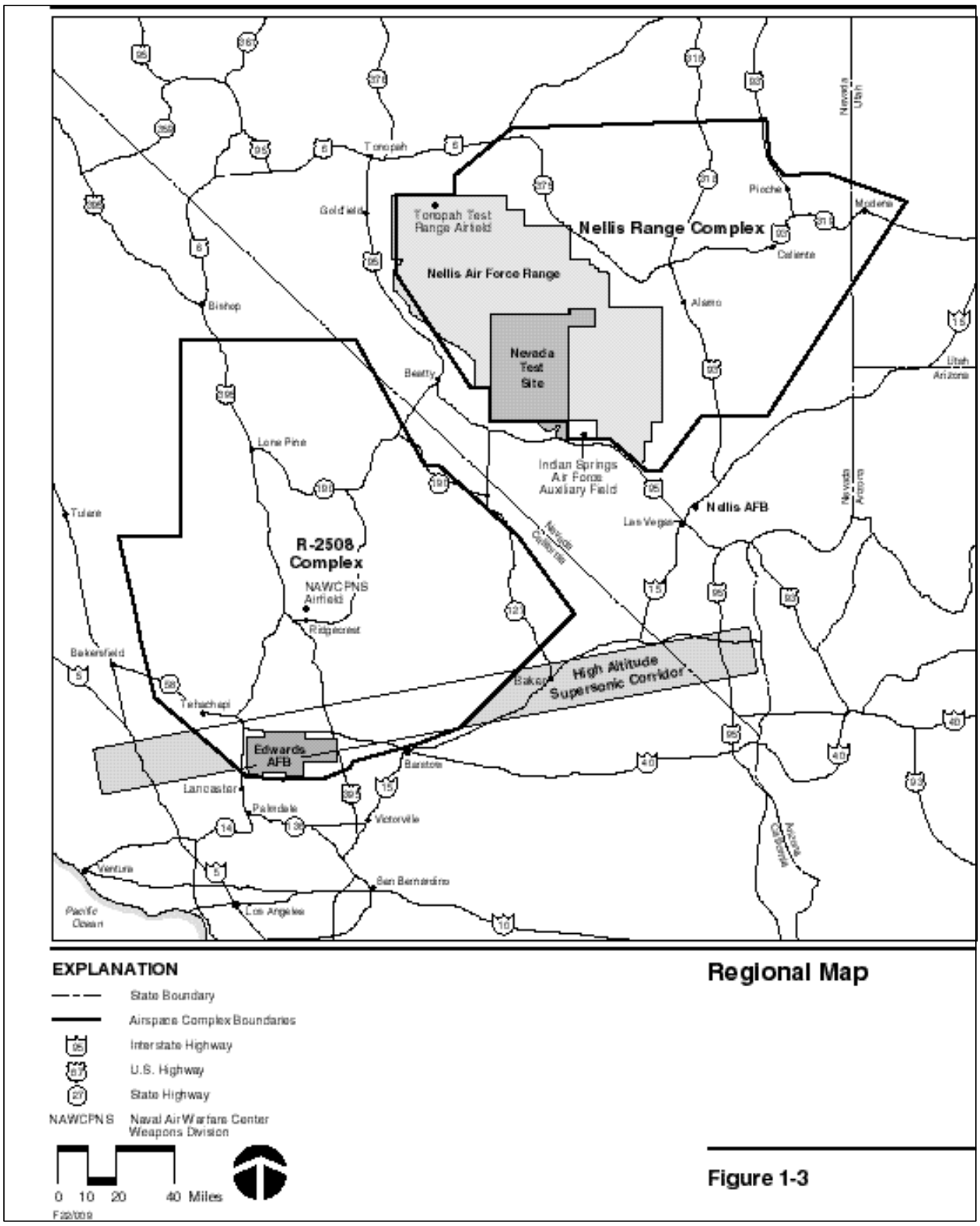
EXPLANATION
State Boundary
County Boundary
Nellis Range Complex Boundary
Interstate Highway
U.S. Highway
State Highway
0 15 30 Miles
F2p/003
Nellis Range Complex and Vicinity Map

Figure 1-2


Tonopah
Goldfield
Tonopah Test Range Airfield
Nellis Range Complex
Nellis Air Force Range
Nevada Test Site
Pioche
Caliente
Alamo
Bishop
Beatty
Lone Pine
Indian Springs Air Force Auxiliary Field
Nellis AFB
Las Vegas
Tulare
R-2508 Complex
NAWC PNS Airfield
Ridgecrest
Bakersfield
Tehachapi
High Altitude Supersonic Corridor
Edwards AFB
Barstow
Lancaster
Palmdale
Victorville
Ventura
San Bernardino
Los Angeles
Pacific Ocean
Nevada
Utah
Arizona
California
EXPLANATION
State Boundary
Airspace Complex Boundaries
Interstate Highway
U.S. Highway
State Highway
NAWCPNS Naval Air Warfare Center Weapons Division
0 10 20 40 Miles
F2p/009
Regional Map
Figure 1-3

Decision Memorandum on August 1, 1991, which authorized the F-22 EMD. EMD contracts were awarded on August 2, 1991.

The F-22 program is currently in the EMD phase, which includes two major types of testing. These are Developmental Test and Evaluation (DT&E), which encompasses Live Fire Test and Evaluation (LFT&E), and Operational Test and Evaluation (OT&E). DT&E is conducted to verify that the F-22 system meets its contractual requirements (specifications). It is usually conducted prior to full-scale production. OT&E is divided into two programs: IOT&E and Follow-on OT&E (FOT&E). IOT&E is designed to test the operational capabilities of the pre-production aircraft (production-representative) under simulated and realistic battle conditions. It is usually conducted prior to the full-scale production of the aircraft. FOT&E is conducted to test capabilities not available during IOT&E or to answer "unanswered questions" from IOT&E. The Force Developmental Evaluation (FDE) tests the post-production aircraft's compatibility with new modifications and tactics. It is conducted throughout the life period of the aircraft. This EA was initiated to assess the environmental effects of the IOT&E program as a result of refinements in the number of F-22s planned for testing, the type of tests planned, and total flight hours allocated to IOT&E since the Advanced Tactical Fighter Full-Scale Development Environmental Assessment (U.S. Air Force, 1991) was prepared. An Environmental Impact Statement (EIS) has been prepared to address the effects of conducting the FDE program at the NRC.

1.2 PURPOSE OF THE ACTION

The purpose of F-22 IOT&E is to comply with 10 U.S.C. Section 2399 and AFI 10-601. This section requires DOD and the Air Force to test major weapon systems before a decision is made to proceed beyond low-rate, initial production. AFI 10-601 also requires testing and evaluation to be conducted in as realistic an operational environment as possible to estimate the system's military utility, operational effectiveness, and operational suitability.

1.3 NEED FOR ACTION

In order to test the F-22's air superiority capabilities, certain operational, technical, and economic conditions must be met. These conditions reflect the combat setting to which the F-22 would be subjected. They are based on the minimum amount of airspace required and the facilities and equipment that will be needed to support the testing of the F-22. These conditions must also meet minimum security and safety requirements that are not part of a combat scenario but are part of the test program's requirements. The criteria used to evaluate IOT&E operational and technical conditions are as follows:

Operational Requirements:

- Airspace:
  - Restricted airspace
  - 60 nautical miles (nm) by 120 nm over land

- Supersonic flight operations authorized.

- Facilities:
  - Dedicated hangars to support four aircraft with polyalphaolefin (PAO) avionics heating/cooling system
  - Alarmed and under constant surveillance
  - Climate-controlled paint facilities
  - Engine Hush House.

- Equipment:
  - Chase planes
  - Flight data collection
  - Aggressor and defender aircraft
  - Ground-tracking and communications ability
  - Ground threat simulators
  - F-22 flight simulators
  - Aerospace ground equipment (AGE).

Technical Requirements:

- Expertise:
  - Flight test
  - Flight test data acquisition, recordation, and analysis
  - Combat tactics and analysis
  - Ground tracking, threat identification, and suppression
  - Security
  - Test aircraft maintenance and repair.

1.4 DECISION MAKER AND DECISION TO BE MADE

The Air Force Operational Test and Evaluation Center (AFOTEC) is the proponent for this Proposed Action. The decision maker for this EA will be the commander of the AFOTEC, Major General William A. Peck, Jr. His decision will be based upon the information contained in this EA and in other sources. The decision to be made is one of the following:

- Approve the FONSI based on the Proposed Action
- Require an EIS
- Choose the No-Action Alternative.

1.5 SCOPE OF THE ENVIRONMENTAL REVIEW

The scope of this EA is "issue driven," meaning that it concentrates only on discussion of those resources that may be adversely affected by the F-22 IOT&E activities. For some resources, an initial analysis indicated that the Proposed Action would result in neither short- nor long-term impacts. These resources are socioeconomics, transportation, utilities, geology and soils, and water resources. The reasons for not addressing these resources are presented in the following paragraphs.

This EA addresses the potential impacts that could occur at Edwards AFB in California, Nellis AFB in Nevada, and the military use airspace where flight activities would occur, which are the R-2508 Complex in California, the HASC in California and Nevada, and the NRC in Nevada and Utah. The transit of aircraft between the R-2508 Complex and the NRC would involve use of nonmilitary-controlled airspace. However, the transit of military aircraft between these areas is a routine activity that occurs in coordination with the Federal Aviation Administration (FAA). All F-22 IOT&E aircraft transits of this area would occur at a minimum altitude of 25,000 feet above mean sea level (MSL) and at subsonic speeds. Flight activities would be transitory only; no maneuvers, training, or simulated combat would occur when transiting FAA-controlled airspace. No change to existing conditions would be expected. For these reasons, no significant impacts to any of the resources addressed in this EA are expected to occur from aircraft transit between these airspace complexes, and impacts to the transit area are not analyzed further in this EA.

Socioeconomics. The 119 additional personnel required for the F-22 IOT&E activities at Edwards AFB would amount to less than a 1-percent increase in the base daytime population of 12,300 persons. This small population increase would not result in a noticeable change in base or regional population or employment. No personnel increases would occur at Nellis AFB. For these reasons, significant impacts to socioeconomics are not expected and are not analyzed in further detail.

Transportation. Assuming all 119 personnel required for F-22 IOT&E activities would be new personnel added to the existing base population, and that all these personnel would use the same road to access the base, there would be a maximum increase of approximately 100 vehicles to the peak hour volume of traffic. This would represent less than five percent of the capacity of a single traffic lane. However, as discussed under socioeconomics, the total population increase associated with F-22 IOT&E may be less than 119. In addition, traffic associated with F-22 IOT&E personnel would likely be spread among the three main access road to Edwards AFB. Therefore, the increase in peak hour volume of traffic at any one location on the base would likely be less. No significant impacts to traffic at Edwards AFB would be expected."

Utilities. F-22 IOT&E utility demands would be similar to other test programs with exception of the utility requirements based on the number of F-22 program personnel. About 119 people are directly associated with the F-22 IOT&E program which equates to approximately 1 percent of the Edwards AFB population. F-22 IOT&E operations associated with Nellis Range Complex activities are supported by Nellis AFB personnel. Therefore, projected personnel increases, maintenance, and test activities, would not significantly increase the utility consumption at Edwards AFB or Nellis AFB. For these reasons, significant impacts to utility systems are not expected and are not analyzed in further detail.

Geology and Soils. F-22 IOT&E activities would not include any construction or other ground-disturbing activities that could alter topography or cause soil erosion

or loss of farmland. For these reasons, significant impacts to geology and soils are not expected and are not analyzed in further detail.

Water Resources. F-22 IOT&E activities would not include any construction or other ground-disturbing activities that would affect surface drainage, surface water quality, or floodplains. No activities that could significantly affect groundwater resources have been identified. For these reasons, significant impacts to water resources are not expected and are not analyzed in further detail.

Resources that may be affected by F-22 IOT&E activities include land use, airspace, hazardous materials/waste management, air quality, noise, biological resources, and cultural resources. Detailed descriptions of the affected environment and the potential environmental consequences relative to these resources are presented in Chapters 3.0 and 4.0, respectively.

1.6 RELATED ENVIRONMENTAL DOCUMENTS

The following environmental analyses are relevant to the F-22 IOT&E and are referenced in this EA.

- Advanced Tactical Fighter Full-Scale Development Environmental Assessment, April 1991
- F-22 Combined Test Force Beddown Environmental Assessment, November 1994
- Environmental Assessment for the Continued Use of Restricted Area R-2515, April 1998
- F-22 Aircraft Force Development Evaluation and Weapons School Beddown, Nellis AFB, Environmental Impact Statement, October 1999
- Tyndall F-22 Beddown Environmental Impact Statement, May 2000.

Copies of these documents are available from the Air Force. An Air Force Point of Contact is provided in Section C of the Cover Sheet for this document.

1.7 APPLICABLE REGULATORY REQUIREMENTS AND COORDINATION

No federal, state, or local permits would be required to implement the F-22 IOT&E phase. The following sections summarize the regulatory coordination that has been conducted as part of the environmental analysis for this EA.

Air Quality. Section 176(c) of the Clean Air Act (CAA), and the regulations that implement it, require that Air Force actions occurring in nonattainment or maintenance areas conform to the applicable State Implementation Plan's (SIP's) purpose of attaining the National Ambient Air Quality Standards (NAAQS). As part of this EA, the Air Force has conducted a conformity applicability analysis for

nonattainment areas in California. The analysis results indicated that emissions associated with the Proposed Action would be in compliance with the applicable SIP. Further conformity determination requirements are not warranted.

Biological Resources. In support of the federal Endangered Species Act (ESA), the Air Force will solicit comments from the U.S. Fish and Wildlife Service (USFWS) concerning the potential impacts to biological resources discussed in this EA.

Cultural Resources. In support of the National Historic Preservation Act (NHPA), which is implemented by 36 CFR Part 800, the Air Force will solicit comments from the California and Nevada State Historic Preservation Officers (SHPOs) and potentially affected Native American groups concerning the potential impacts to cultural resources discussed in this EA.

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2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

This chapter describes the Proposed Action, which is the F-22 IOT&E program, and the No-Action Alternative. In addition, it includes a brief discussion of the alternatives considered but eliminated from further study, and a comparative analysis of the impacts of the Proposed Action and No-Action Alternative.

2.1 DESCRIPTION OF THE PROPOSED ACTION

The proposed F-22 IOT&E program would occur at Edwards AFB and would be conducted over the R-2508 Complex and the NRC. This approach presents the best combination for conducting the IOT&E program. Edwards AFB and the R-2508 Complex is the Air Force's recognized center for testing experimental and new aircraft. It is also the site of the F-22 DT&E program. By basing the F-22 IOT&E program there, the Air Force will be able to take advantage of the facilities and personnel already in place supporting the F-22 DT&E program. The NRC, along with its host base, Nellis AFB, is the Air Force's center for combat tactics. The NRC is a short distance from Edwards AFB and the R-2508 Complex. This proximity allows opportunity for testing of the F-22's combat capabilities against the threat emitters and simulators on the range and provides a realistic combat environment.

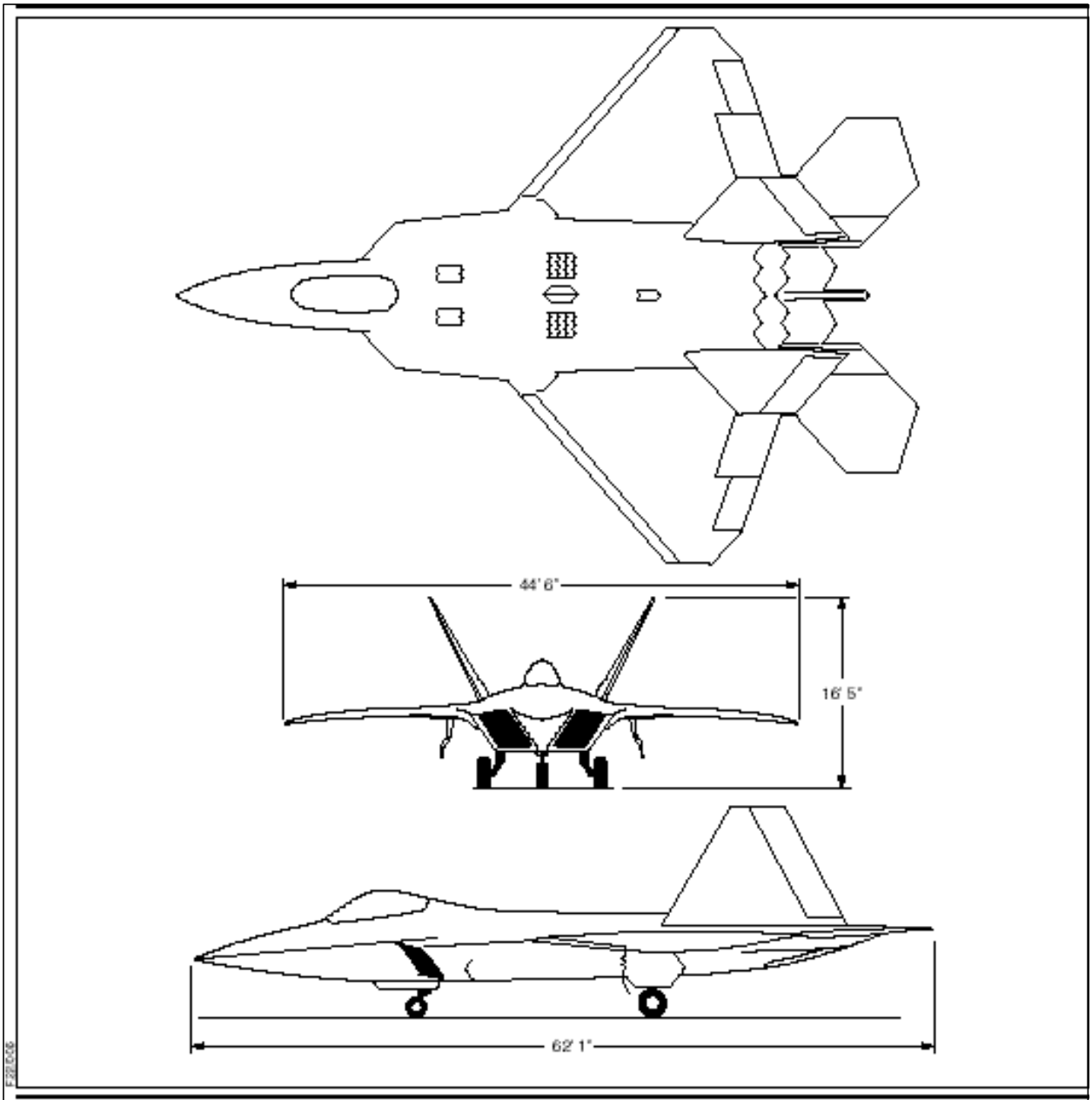
The IOT&E program would entail the testing of 4 F-22s over a 10- to 12-month period beginning in spring 2002. Ground operations and maintenance tests would be performed at Edwards AFB. Pilot training, aircraft familiarization, and some flight test activities for the F-22 and F-16 chase planes would be conducted over the R-2508 Complex. Some pilot training would also occur over the NRC; however, the majority of flight activities conducted over the NRC would be the testing of the F-22's combat capabilities. The following sections provide descriptions of the F-22 aircraft and the ground and flight operations and personnel requirements for the Proposed Action.

2.1.1 Characteristics of the F-22 Aircraft

The F-22 aircraft is similar in scale to the F-15C (i.e., approximately 62 feet long, 44 feet wide, and 17 feet high at the tail) (Figure 2-1). Prior testing and noise measurements conducted on the F-22 indicated that the noise generated by the F-22 is also similar to that generated by the F-15C.

The airframe is constructed of advanced metals and composite materials to minimize weight and corrosion while maximizing survivability and performance. Two "Super Cruise" F-119 Pratt and Whitney 100 engines are housed within each F-22 aircraft. The F-22 has the unprecedented ability to cruise at supersonic speeds without using an afterburner. The F-22's power-generating systems (i.e.,

the F-119 engines, auxiliary and emergency power units) use JP-8, a low-sulfur and low-metal aircraft fuel. Lithium ion or nickel-cadmium batteries support the



F-22 Aircraft

Figure 2-1

electrical power system. Aircraft hydraulic systems use a fire-resistant hydraulic fluid.

The environmental control system provides heating, cooling, and pressurization for the pilot, avionics, and fuel system. A non-ozone-depleting compound refrigeration package pulls heat from the cabin, fuel, and avionics sources.

Fire protection systems on the F-22 IOT&E aircraft will use hydrochloro-fluorocarbon (HCFC)-125, a non-ozone-depleting compound for fire zones. The HCFC-125 system is activated by the pilot and is intended to be used only in emergency situations. The on-board inert gas generating system will be used for aircraft fuel tank explosion suppression to prevent ignition of vapors inside fuel tanks. The system generates nitrogen to displace oxygen as the fuel tanks empty.

The F22's radar system, which is mounted in its nose section, is not operated on the ground other than for maintenance purposes. Radar maintenance is conducted in accordance with standard operating procedures and includes establishment of safety zones from which all personnel are to be excluded during radar testing.

The armament system includes an internal weapon carriage system and an internally mounted gun system. The internal weapon system is designed to launch air-to-air missiles, as well as drop air-to-ground munitions. The gun system is built around a 20-millimeter (mm) cannon. External pylons can be used for carriage of external fuel tanks or additional air-to-air missiles.

2.1.2 Ground Operations

Ground operations would consist of maintenance, flight preparation, and flight tracking activities. Maintenance and flight preparation activities would primarily occur at Edwards AFB. No routine use of ground facilities at any other location is planned for the F-22 IOT&E; however, a number of divert locations may be used for contingency refueling, minor maintenance, or in case of emergencies. These locations include Nellis AFB, Tonopah Test Range Airfield, and Indian Spring Air Force Auxiliary Airfield, all situated in Nevada, and the Naval Air Warfare Center Weapons Division (NAWCPNS) in California (formerly known as China Lake Naval Weapons Center) (see Figure 1-3). Nellis AFB would be the primary divert location and is addressed as such in this EA. The other divert locations would be used too infrequently, if at all, to assess any potential impacts from F-22 IOT&E activities. Tracking of flights would require use of ground-based tracking systems at both Edwards and Nellis AFBs.

2.1.2.1 Edwards Air Force Base.

Ground operations at Edwards AFB would consist of maintenance and flight preparation activities for up to four F-22 aircraft, which would be staged at Edwards AFB for IOT&E activities. These activities would occur during the 10- to

12-month flight test time frame from spring 2002 through winter 2003. F-22 IOT&E at Edwards AFB would also include tracking activities.

Maintenance Activities. Both scheduled and unscheduled maintenance activities could occur. Scheduled maintenance includes phase, pre-flight, thru-flight, hourly post-flight, and basic post-flight. Unscheduled maintenance would be performed as needed.

Typical maintenance activities include corrosion control, painting, low observable repair, aircraft washdown, and system/subsystem repairs and servicing. The system/subsystem repairs include stores management; vehicle management; engine; electrical power; fire protection; flight control; hydraulic landing gear; arresting gear; auxiliary power; environmental control/thermal management; crew escape/canopy; life support; avionics; electrical warfare; radar; and communication, navigation, and identification. Servicing includes adding petroleum, oil, and lubricants (POL) and various other fluids to maintain proper levels. Hazardous materials used during these activities would include primers, topcoats, various coatings, solvents, sealants, epoxies, solder, paint and epoxy strippers, adhesives, refrigerants, coolants, hydraulic fluids, cleaners, adhesives, POL, and degreasers. Hazardous materials requirements for the F-22 program at Edwards AFB are outlined in the Advanced Tactical Fighter Full-Scale Development Environmental Assessment (U.S. Air Force, 1991).

A Hazardous Materials Distribution Support Center (HDSC) Operating Instruction is currently in the process of being established for the F-22 program at Edwards AFB and would be in place prior to initiation of IOT&E activities. The HDSC Operating Instruction will incorporate the requirements of the F-22 program into the hazardous materials pharmacy (HAZMART) system, and all F-22 personnel will be trained in the use of the HDSC.

The F-22 would be staged at the F-22 Combined Test Force (CTF) site on the Edwards AFB flightline (Figure 2-2). The CTF provides facilities for testing and maintenance of the F-22 aircraft and includes 3 aircraft hangars (Facilities 1870, 1874, and 1881) that would be used to house the F-22s. Renovation and construction activities to create the F-22 CTF have been documented in the F-22 Combined Test Force Beddown Environmental Assessment (U.S. Air Force, 1994b). The F-22 CTF facilities formerly housed F-15 and C-130 aircraft but are currently being used for the F-22 program.

Additional facilities within the F-22 CTF that would support the F-22 activities include the following:

- **Facility 1884** - Warehouse storage of aircraft parts
- **Facility 1875** - Minor maintenance of Aerospace Ground Equipment (AGE)
- **Facility 1859** - Maintenance of F-22 armaments.

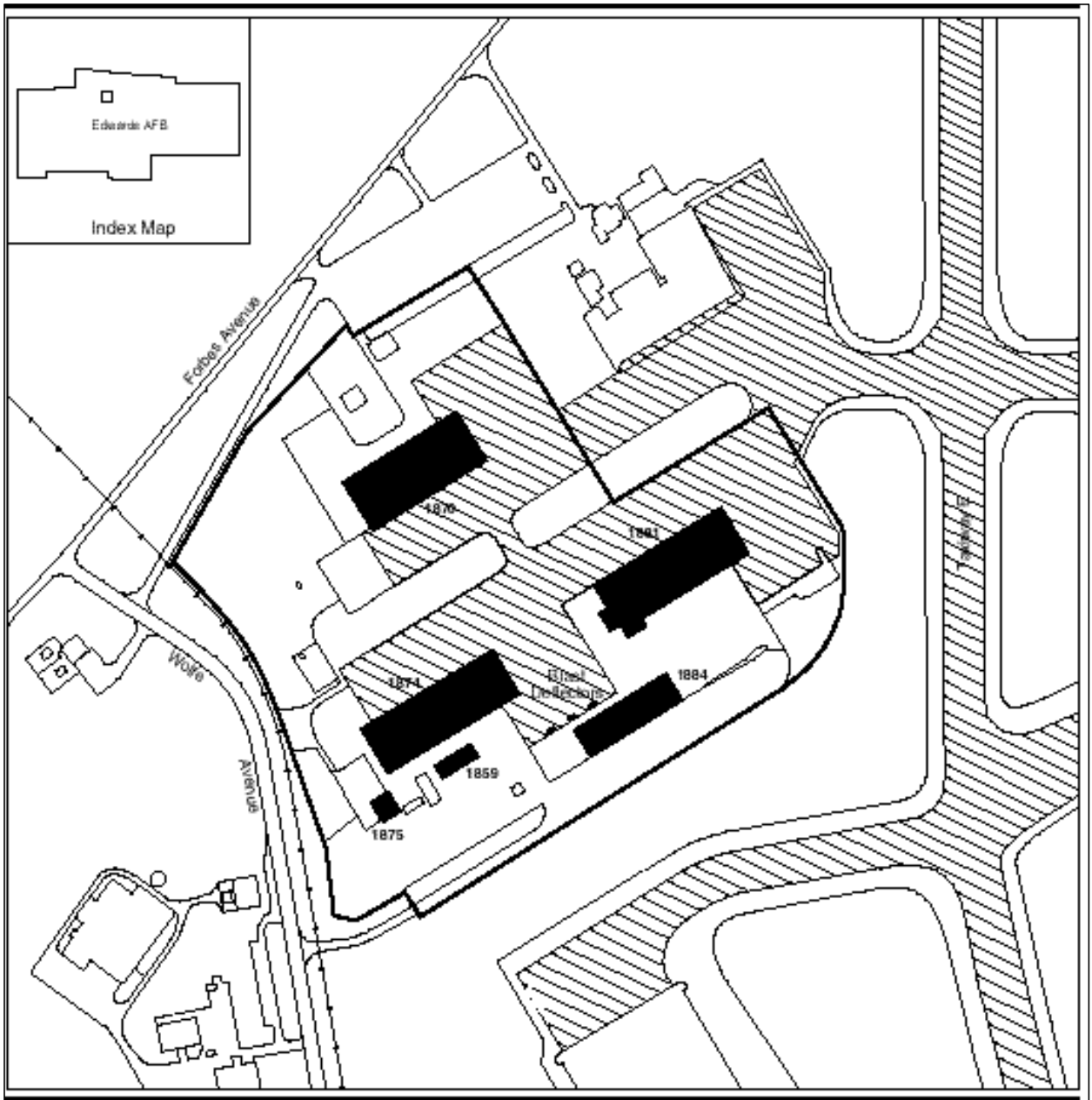

Edwards AFB
Index Map
Forbes Avenue
Wolfe
Avenue
1870
1881
1874
1884
1859
1875
EXPLANATION
Combined Test Force Site Boundary
Taxiway and Apron Areas
0 100 200 350 Feet
F-22 Combined Test Force Site, Main Base, Edwards Air Force Base

Figure 2-2

Existing base assets that support other ongoing flight testing and maintenance activities at Edwards AFB would also be used to support F-22 IOT&E (Figure 2-3). These facilities include the following:

- **Facility 1020 (Integrated Flight Acquisition Support Test Facility)** - Conduct tests on the aircraft's radar
- **Facility 1440 (Ridley Control Room)** - Flight track support
- **Facility 1600A (Corrosion Control Facility)** - Touch-up painting of the aircraft
- **Facility 1735 (Hush House) -** Uninstalled or installed maintenance engine run-ups
- **Facility 1899 (Test Cell)** - Installed maintenance engine run-ups
- **Facility 3800** - Storage of F-119 engines
- **Facility 3810** - Maintenance of jet engines
- **Facility 1622/1624 (Fuel System Repair Facility)** - Removal and installation of F-22 fuel system components (aircraft not facility) and repair of F-22 fuel tank (aircraft not facility) leaks.

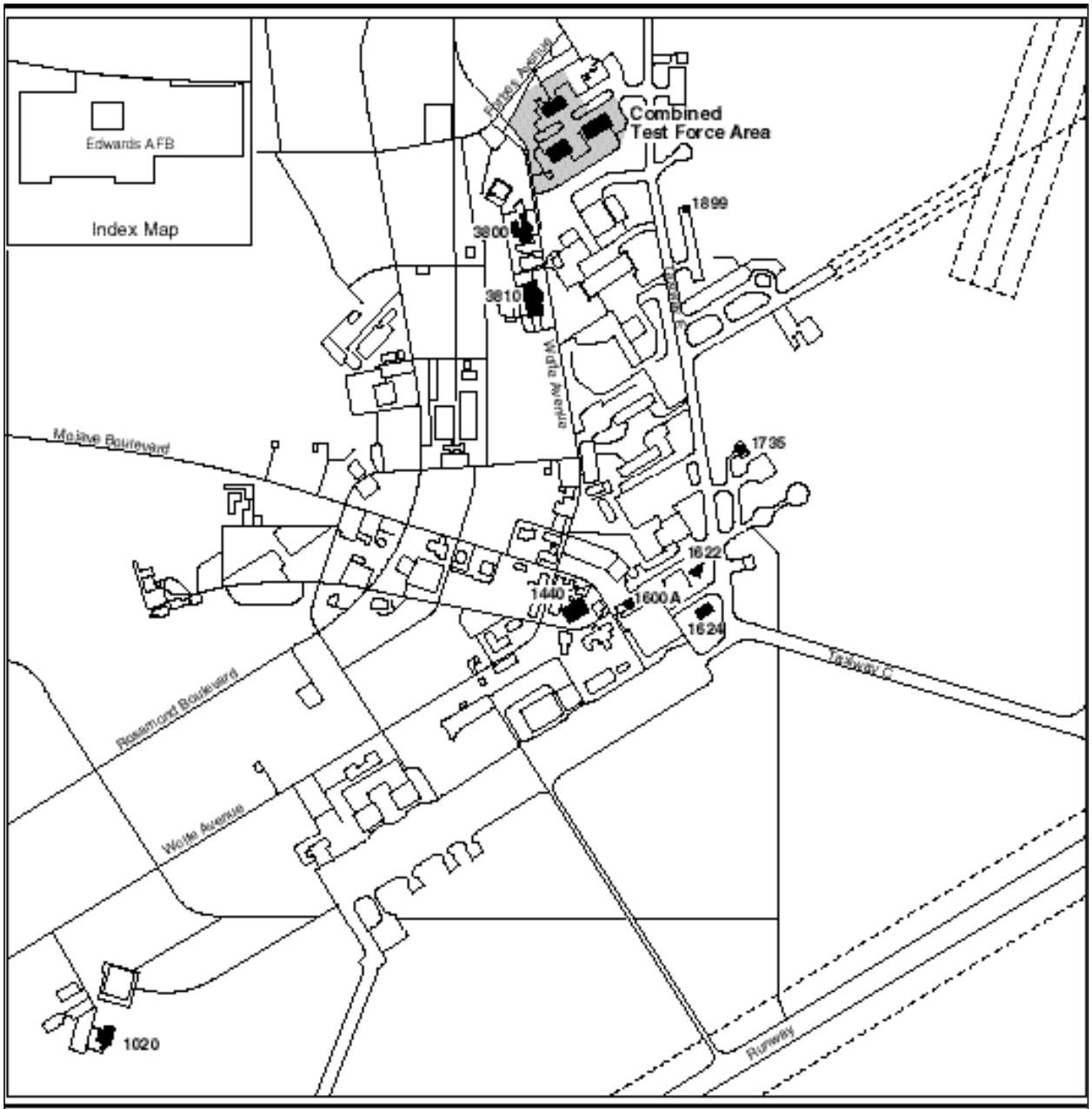
Maintenance engine run-ups would be conducted on both installed and uninstalled F-22 engines. Idle leak checks and military power engine runs on uninstalled engines would be conducted in the Hush House approximately once per month for each engine.

Maintenance engine run-ups conducted on installed F-22 engines would take place in the Test Cell. Idle leak check and 80-percent leak check engine runs would each be conducted 3 times per month per aircraft. Military power runs, which include afterburner run-ups, would occur once per month per aircraft. Both engines would be tested during each run.

In addition, a number of facilities would be utilized to indirectly support the F-22 IOT&E activities. These include facilities not directed to support specific aircraft programs where activities such as AGE maintenance and portable battery charger maintenance and repair are conducted.

AGE would be used during routine maintenance of the aircraft to provide supplemental lighting, external power, and cooling to the aircraft. AGE usage during routine maintenance of the aircraft would be similar to that required for other aircraft, except for the addition of a PAO cart containing antifreeze/coolant used for the avionics in the F-22.

Flight Preparation. Flight preparation activities would include servicing the F-22s and performing pre-flight checks. The two methods used for fueling are the existing hydrant fueling system and mobile refueling trucks. Pre-flight checks


Edwards AFB
Index Map
Combined
Test Force Area
1899
3800
3810
Wolfe Avenue
Mojave Boulevard
1735
1622
1440
1600A
1624
Rosamond Boulevard
Wolfe Avenue
1020
Runway
EXPLANATION
Support Facilities
F-22 IOT&E Support
Facilities, Main Base,
Edwards Air Force Base
0 500 1000 2000 Feet
Figure 2-3

are conducted prior to each takeoff and include engine stabilization, pre-launch inspection, and taxiing the aircraft to the runway.

Flight Tracking. Flight tracking activities would entail use of existing range tracking facilities operated by Edwards AFB personnel. These facilities are currently being used for F-22 DT&E activities. The Ridley Control Room (Facility 1440) may be used during IOT&E flight tests conducted in the NRC.

2.1.2.2 Nellis Air Force Base.

Refueling, minor maintenance, or emergency ground operation activities may need to be conducted at several divert locations. The primary divert location would be Nellis AFB. These activities would occur on a contingency basis only at Nellis AFB. Ground-based flight tracking would also be conducted during flight tests in the NRC.

Maintenance Activities. If required, minor maintenance or emergency operations would be conducted in existing facilities where these types of activities are routinely performed. No facilities would be dedicated to supporting the F-22 IOT&E, and no Nellis AFB facilities would be modified. F-22 maintenance activities would be conducted at Nellis AFB on a contingency basis only, and the level of activity at the base to support F-22 IOT&E activities is expected to be minimal.

Flight Preparation. At Nellis AFB, the F-22 would be fueled on the aircraft parking apron at designated aircraft parking spots.

Flight Tracking. Ground-based flight tracking facilities on the Nellis Air Force Range (NAFR), which underlies part of the NRC airspace (see Figure 1-2), would be used to collect flight data during flight tests. Existing facilities manned by Nellis AFB personnel would be used. Use of these facilities and personnel is a part of ongoing, routine range activities; no special operations for ground-based tracking support would be required for the F-22 IOT&E-phase activities.

2.1.3 Flight Activities

The IOT&E phase includes a series of pilot training flights over several months followed by several months of test flights. All F-22 flights would originate and terminate at Edwards AFB, although Nellis AFB facilities may be used in emergencies. IOT&E pilot training flights are scheduled to commence in spring 2002 at Edwards AFB. After completion of the initial pilot training flights at Edwards AFB, the F-22s would transit to the NRC for additional pilot training and flight tests that would continue through winter 2003. One F-15C or F-16C aircraft would be used as a safety chase plane (if required) for F-22s transitioning between Edwards AFB and NRC airspace. IOT&E flight test activities would consist of two-, and four-ship missions to evaluate the F-22's performance in representative combat scenarios. Support aircraft used in flight test combat scenarios would include F-16Cs, F-15C/Es, and EA-6Bs. Both pilot training and

test flights would require use of KC-10 or KC-135 tanker aircraft for aerial refueling. Flight tests would use E-3 Airborne Warning and Control System (AWACS) aircraft for fighter control. Support, tanker, and AWACS aircraft would be reassigned from other missions at Edwards AFB and the NRC to support the F-22 IOT&E.

F-22 pilot training flight hours are estimated to be 606 over 5 months. F-22 test flight hours are estimated to be 753 over 5 to 7 months. Support aircraft hours are estimated to be 2,537. Tanker and AWACS flight hours are estimated to be 813 and 571, respectively. A breakdown of proposed flight test activities is provided in Tables 2-1 and 2-2.

Table 2-1. Proposed F-22 IOT&E-Phase Flight Activity

Test Range	Month	Sorties[(a)(b)]	Flight Hours[(c)]
Edwards Airspace[(d)]	Mar-May 02	144[(e)]	295
	Jul 02	60[(f)]	108
Edwards Airspace[(d)] Total		204[(g)]	403
NRC	May-Jul 02	173[(e)]	311
	Aug 02-Jan 03[(h)]	358[(i)]	645
NRC Total		531[(i)]	956
IOT&E Total		735[(i)]	1,359

Notes:
(a) A sortie is defined as a scheduled event consisting of a take-off, flight, and a landing.
(b) All F-22 sorties originate and end at Edwards AFB.
(c) Flight hours reflect flown events based upon anticipated effectiveness rates.
(d) Edwards airspace includes R-2508 Complex and HASC.
(e) Pilot training flights.
(f) Sortie surge demonstration flights (IOT&E event). A sortie surge is a launch of all flight worthy aircraft(F-22s) that is conducted within as short a time frame as safely possible.
(g) Does not include the 531 transits between the R-2508 Complex and the NRC.
(h) Flight testing may continue into February 2003 if scheduled sorties per month goal is not accomplished by December 2002.
(i) Within the NRC, one F-22 IOT&E sortie is equivalent to 10 sortie operations.

AFB = Air Force Base
HASC = High-Altitude Supersonic Corridor
IOT&E = Initial Operational Test and Evaluation
NRC = Nellis Range Complex

Pilot training and flight tests would be conducted at both subsonic and supersonic speeds. Ten percent or less of IOT&E flight tests would be conducted during nighttime hours. All F-22 flight tests would take place at altitudes greater than 3,000 feet above ground level (AGL). Support aircraft (F-15, F-16, and EA-6B) engaged in combat capability tests would fly at altitudes greater than 3000 feet AGL with exception of combat tests taking place in R-4807A which is authorized for supersonic flights above 500 feet AGL. All F-22 and support aircraft flight activities would be flown in accordance with the existing restrictions (i.e., altitude, speed, time, or avoidance area restrictions) applicable to the airspace in which the

F-22 is being flown. No modifications to existing airspace would be made. Supersonic flights would be conducted only in existing supersonic airspace corridors and in approved airspace. All flights would occur in existing military use

Table 2-2. Proposed F-22 IOT&E-Phase Support, AWACS, and Tanker Flight Activity

Test Range	Month	Support Sorties[a][b]	Support Flight Hours[c]	AWACS Sorties[a][d]	AWACS Flight Hours[c][d]	Tanker Sorties[a][e]	Tanker Flight Hours[c][e]	Total Sorties[a][f]	Total Flight Hours[c][f]
Edwards Airspace[g]	Mar-May 02	44[h]	50	0	0	12	54	200	399
	Jul 02[i]	0	0[i]	0	0	0	0	60	108
Edwards Airspace[g] Total		44[h]	50	0	0	12	54	260	507
NRC	May-Jul 02	206[h]	591	0	0	12	54	391	956
	Aug 02-Jan 03[j]	1,224[k]	1,896	127	571	157	705	1,866	3,817
NRC Total		1,430	2,487	127	571	169	759	2,257	4,773
IOT&E-Phase Total		1,474	2,537	127	571	181	813	2,517	5,280

Notes: (a) A sortie is defined as a scheduled event consisting of a take-off, flight, and a landing, associated with a mission taking place within the designated airspace.
All F-22 sorties originate and end at Edwards AFB.
Flight hours reflect flown events based upon anticipated effectiveness rates.
(d) E-3 AWACS aircraft.
(e) KC-10 or KC-135 aircraft.
(f) Includes F-22 flights from Table 2-1.
(g) Edwards airspace includes R-2508 Complex and HASC.
(h) F-16 aircraft only during pilot training.
(i) F-22 sortie surge demonstration; no support aircraft required. A sortie surge is a launch of all flight worthy aircraft(F-22s) that is conducted within as short a time frame as safely possible.
(j) Flight testing may continue into February 2003 if scheduled sorties per month goal is not accomplished by December 2002.
(k) F-15C/E, F-16C, and EA-6B aircraft.

AWACS = Airborne Warning and Control System
HASC = High-Altitude Supersonic Corridor
IOT&E = Initial Operational Test and Evaluation
NRC = Nellis Range Complex

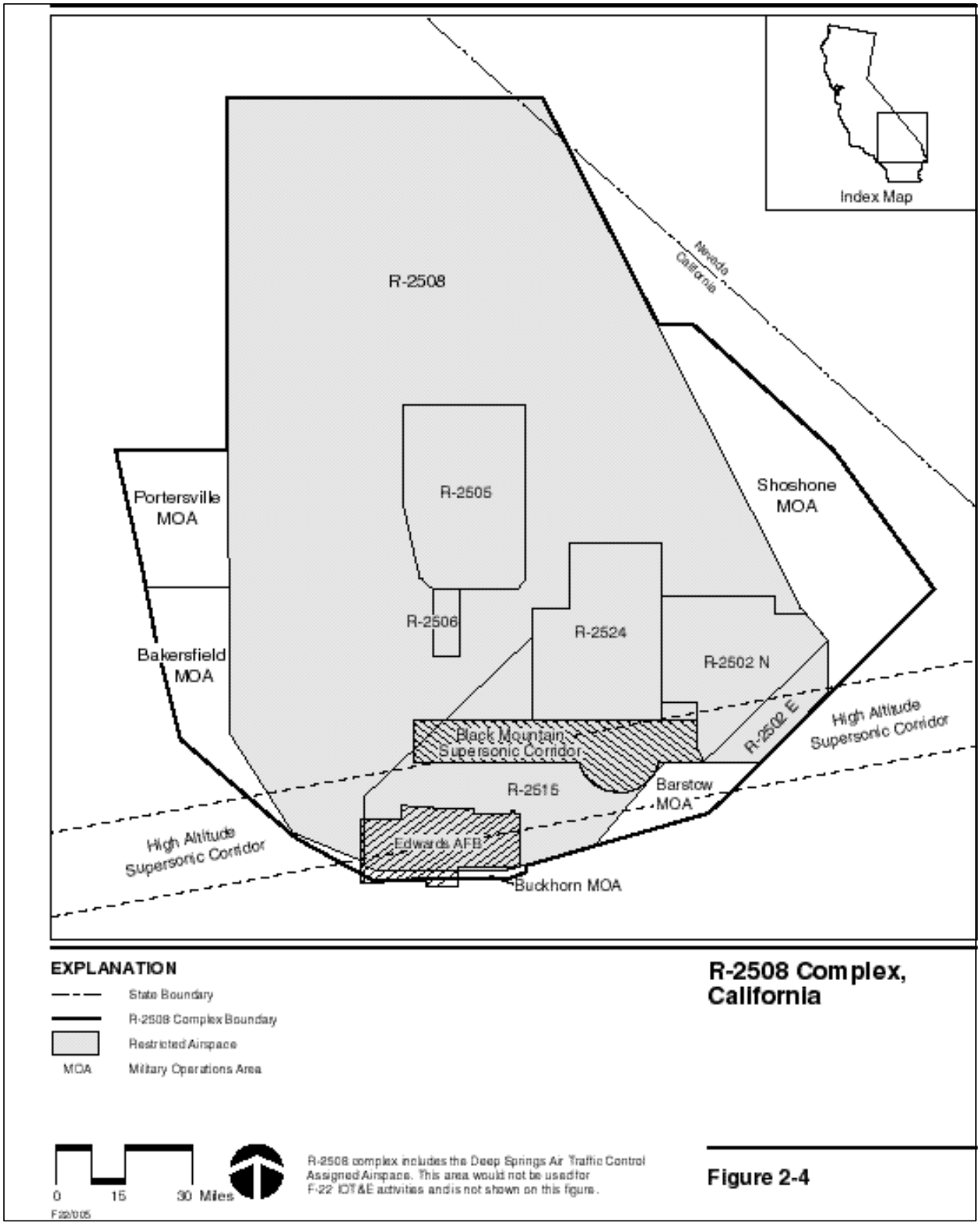
airspace, with the possible exception of tanker orbit flights, which could occur in adjacent airspace, as approved by the FAA. F-15C or F-16C chase planes (if required) and F-22s would use FAA-controlled, high-altitude airspace when transitioning between the two airspace complexes. These transits would occur at a minimum altitude of 25,000 feet MSL and at subsonic speeds.

No live fire testing of the F-22's guns, missiles, or bombs would be conducted during the IOT&E program. All flights would be conducted with internally carried weapons, but no live fire tests or releases of armament would be conducted. The test aircraft would carry inert training missiles (air intercept missile [AIM]-9s and AIM-120s) and live 20mm ammunition for ballast. During IOT&E, no assets (armaments) would be released from the aircraft.

2.1.3.1 Edwards Air Force Base.

At Edwards AFB, pilot training and sortie surge demonstration flights would be conducted within the R-2508 Complex and the HASC (see Figure 1-1). An estimated 144 F-22 sorties (295 flight hours [see Table 2-1, footnote "e"]) and 44 F-16 sorties (50 flight hours [see Table 2-2, footnote "h"]) would be flown during a 3-month period in spring 2002 for pilot training. After completion of the initial pilot training flights at Edwards AFB, all F-22 sorties would continue to originate at Edwards AFB but would transit to the NRC for additional pilot training and flight tests. An additional 60 F-22 sorties (108 flight hours) would take place in Edwards AFB airspace during July 2002 for sortie surge demonstration, as part of the F-22 IOT&E. Sortie surge flights are conducted to test the system's ability for rapid turnaround. Aside from pilot training and sortie surge flights, the R-2508 Complex airspace may also be used occasionally for F-22 functional check flights. These flights would be conducted, as required, after maintenance work has been performed on an aircraft. F-22s transitioning from the R-2508 Complex to the NRC would be accompanied by an F-16C chase aircraft. These F-16 sorties could originate and terminate at either Nellis AFB or Edwards AFB.

Airspace associated with Edwards AFB consists of the R-2508 Complex and the HASC. The R-2508 Complex is composed of restricted airspace, Military Operations Areas (MOAs), the Black Mountain Supersonic Corridor, and Air Traffic Control Assigned Airspaces (ATCAAs). Figure 2-4 shows a composite of this area, which is described in more detail in Section 3.2.1. Pilot training flights would be conducted at subsonic and supersonic speeds. Each pilot training sortie would include supersonic flight but it would occur only in authorized areas within the R-2508 Complex and the HASC. Low-level supersonic flights, as low as 3,000 feet AGL, would occur in portions of the Black Mountain Supersonic Corridor east of U.S. Highway 395 in accordance with existing airspace usage restrictions. Supersonic flights above 30,000 feet AGL would take place in the HASC. Supersonic operations could occur in other areas of the range as allowed. The other airspace would be used for subsonic flights only. When required, tankers supporting pilot training would fly to and from the R-2508 Complex airspace from various bases.



R-2508 Complex, California

Figure 2-4

2.1.3.2 Nellis Range Complex, Nevada and Utah.

The NRC would be used to conduct F-22 pilot training and flight tests simulating combat conditions. These activities would utilize the NRC, which consists of restricted airspace that approximately overlays the NAFR and includes the Desert and Reveille MOAs (Figure 2-5). This airspace is described in more detail in Section 3.2.2. All F-22 and support aircraft flight activities would occur in accordance with the existing restrictions of these airspaces. Approximately 20 percent of F-22 flight hours would be supersonic; supersonic events would occur at least once during each flight test and could occur more frequently. Supersonic flights would occur only in authorized areas within the NRC. Figure 2-5 shows the areas where supersonic flight is prohibited. F-22 supersonic flights as low as 3,000 feet AGL would occur, as allowed, only in portions of the R-4807A airspace; support aircraft may fly at supersonic speeds as low as 500 feet AGL, as allowed, in this same area. Supersonic flights in other authorized areas would occur at a minimum of 5,000 feet AGL for all aircraft in accordance with existing airspace usage restrictions.

A total of 531 F-22 sorties, within the NRC, one F-22 IOT&E sortie is equivalent to 10 sortie operations, (956 flight hours) and 1,726 support, tanker, and AWACS sorties (3,817 flight hours) would be flown on the NRC during a 7- to 9-month period from late spring 2002 through winter 2003 (see Table 2-1). Flight control would require use of AWACS aircraft to provide air picture and control information. Two aerial refuelings of the F-22 may occur during each flight test sortie (pre- and post-test event); aerial refueling of support aircraft may also occur. Refueling activities would occur within the NRC or in areas adjacent to military use airspace. Use of adjacent airspace would require coordination with the FAA in accordance with routine scheduling procedures. All F-22 flights would originate from Edwards AFB. All support aircraft flights, except AWACS and tankers and possibly F-16 safety/support, would originate from Nellis AFB where these aircraft would be based or assigned for temporary duty. AWACS would not be based at Nellis AFB but may land and take off from the base. Tankers would fly to and from NRC airspace from various bases. Flight tests may include release of countermeasure materials, such as chaff and flares. These would be released only in areas on the NAFR approved for these activities.

2.1.4 Personnel Summary

Approximately 119 people would support the F-22 IOT&E program activities at Edwards AFB. Of these, approximately 97 would occupy new, permanent positions required for the Proposed Action. However, some of the new positions may be filled by personnel currently employed at Edwards AFB, who would transfer from other programs. These personnel would perform routine maintenance, support ground-based flight tracking, and conduct administrative actions, analyze flight test data, fly or support the F-22 aircraft, and perform test operations.

Existing personnel at Nellis AFB would perform any required refueling, minor maintenance, or emergency ground operations and range control and tracking activities.

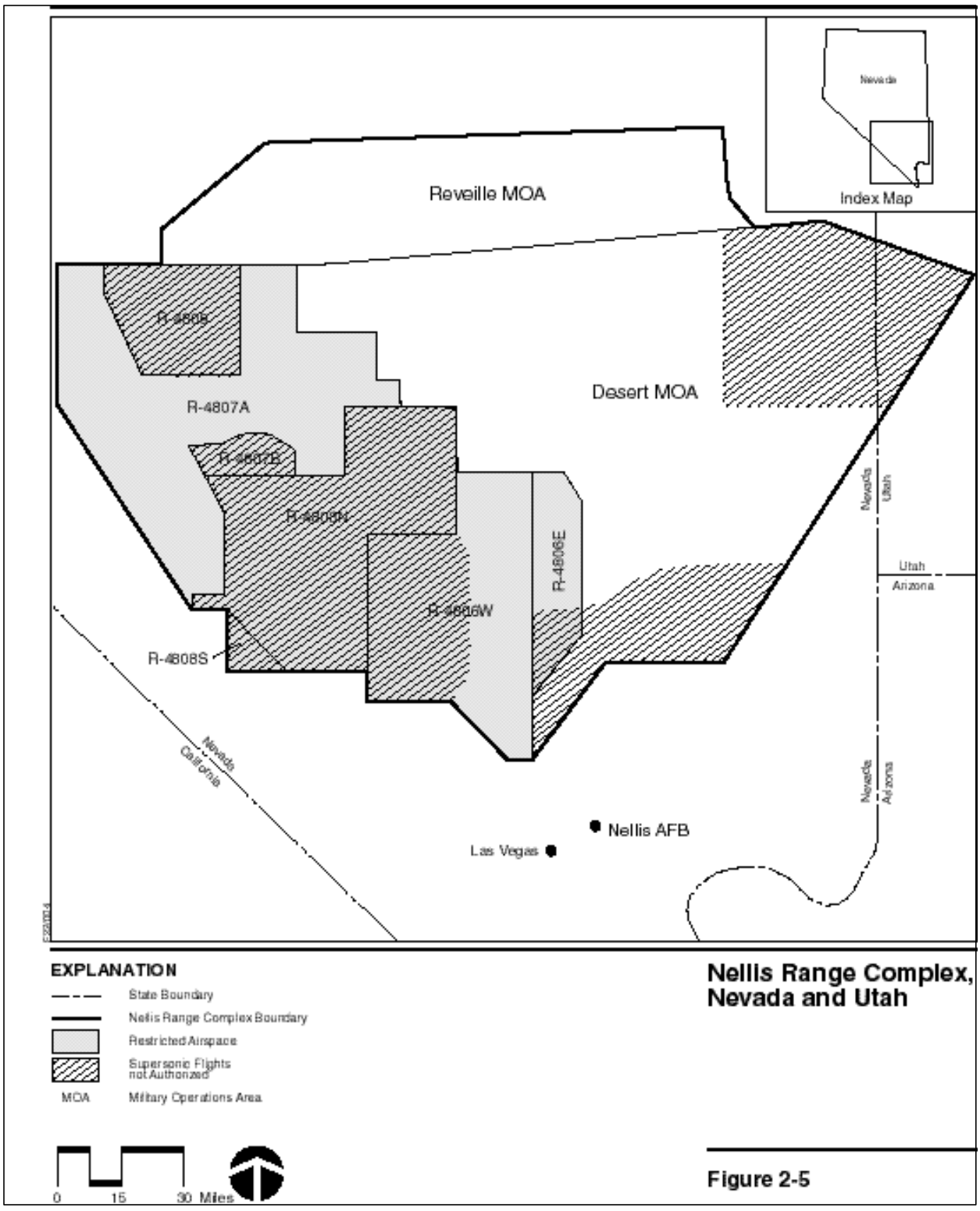

Nevada
Index Map
Reveille MOA
R-4805
R-4807A
R-4807B
R-4808N
R-4806E
R-4806W
R-4808S
Desert MOA
Nevada
Utah
Utah
Arizona
Nevada
California
Nevada
Arizona
Nellis AFB
Las Vegas
EXPLANATION
State Boundary
Nellis Range Complex Boundary
Restricted Airspace
Supersonic Flights not Authorized
MOA
Military Operations Area
0
15
30 Miles
Nellis Range Complex, Nevada and Utah

Figure 2-5

2.2 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER STUDY

Locations other than those depicted in the Proposed Action and combinations using portions of the Proposed Action and other locations were evaluated and eliminated from further study. The evaluation was based on the criteria presented in Section 1.2 of this EA and on economic and environmental criteria as well.

Alternative test locations that were evaluated include Eglin AFB, Tyndall AFB, and the Eglin Military Complex (EMC) in Florida and the Patuxent River Naval Air Station in Maryland. The following criteria were used in the evaluation:

Statutory and Regulatory Requirements:

- Test:
  - 10 U.S.C. Section 2399 - IOT&E must be conducted before full-scale production is initiated.

- Conditions:
  - AFI 10-601 – Realistic mission level and simulated combat conditions.

Operational Requirements:

- Airspace:
  - Restricted airspace
  - 60 nm by 120 nm over land (7,200 sq nm)
  - Authorized supersonic flight operations.

- Facilities:
  - Alarmed and surveyed facilities
  - Dedicated hangars to support four aircraft with PAO avionics heating/cooling system
  - Climate-controlled paint facilities
  - Engine Hush House.

- Equipment:
  - Chase planes
  - Flight data collection
  - Aggressor and defender aircraft
  - Ground threat simulators
  - Flight data collection and recordation
  - Ground-tracking and communications
  - F-22 flight simulators
  - AGE.

Technical Requirements:

- Expertise:
  - Flight test
  - Combat tactics
  - Security

- Test aircraft maintenance and repair.

Economic Requirements:

- Budgetary:
  - Must not increase cost without justifiable offset in operational or technical areas.

Environmental Requirements:

- Sensitivities:
  - Action must not produce an environmental impact that cannot be mitigated.

Eglin AFB, Tyndall AFB, and the EMC is the Air Force's center for electronics and munitions testing. This alternative was eliminated because it did not meet AFOTEC's minimum airspace criterion (7,200 sq nm over land required versus EMC's 547 sq nm over land).

The Naval Air Warfare Center Air Division (NAWCAD) at Patuxent River Naval Air Station and R-4008 is the Navy's equivalent to the Air Force Flight Test Center (AFFTC) at Edwards AFB. NAWCAD was eliminated because it did not meet AFOTEC's minimum airspace criterion (7,200 sq nm over land required versus NAWCAD's 588 sq nm over land) of the operational requirement.

Four combinations for basing and testing were also evaluated. They included: (1) conducting the IOT&E program entirely at Edwards AFB and R-2508 Complex; (2) conducting the IOT&E program entirely at Nellis AFB and the NRC; (3) basing the F-22s at Eglin AFB and conducting the tests in the R-2508 Complex and NRC; and (4) basing the F-22s at Patuxent River Naval Air Station and conducting the tests at the R-2508 Complex and NRC. The Edwards AFB and R-2508 Complex combination was eliminated because it does not have the combat test infrastructure that the NRC does. Conversely, the Nellis AFB and the NRC combination does not have the flight test infrastructure or type of maintenance and repair capabilities that Edwards AFB and the R-2508 Complex has. The third and fourth combinations were eliminated due to the economic costs incurred in traveling between the installations and ranges, eliminating any benefits the combinations may provide. No other reasonable alternatives to the Proposed Action were identified.

2.3 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, the F-22 IOT&E program would not be conducted. No F-22 IOT&E flight tests would be conducted at Edwards AFB and the NRC, and consequently, the F-22 program would be terminated. Since this could not happen without Congressional notification, it is more likely that the Air Force, through DOD, would seek a waiver from Congress to 10 U.S.C. Section 2399. The waiver would either request exemption from the tests or seek approval for a lesser degree of compliance with the statute. If the second approach is adopted, a new set of criteria could be developed that could make one of the alternatives identified in

Section 2.2 viable. The risk associated with taking either approach is that the test may fail to detect a critical weakness until the F-22 is engaged in actual combat.

2.4 COMPARISON OF ENVIRONMENTAL IMPACTS

This section presents a summarized comparative analysis of the Proposed Action and No-Action Alternative. Detailed discussions of the potential effects of the Proposed Action and No-Action Alternative are presented in Chapter 4.0, Environmental Consequences.

Land Use. Proposed Action activities would occur in existing facilities on Edwards AFB and would not require any changes to land use. Noise levels generated by F-22 aircraft ground operations would be comparable to existing and past noise levels in these areas, with exception of startup and taxiing activities. Startup and taxiing are further discussed in the following paragraph titled Noise. F-22 aircraft airspace operations would occur within existing usage requirements within existing military use airspace and would produce noise levels comparable to those of existing aircraft operating in the R-2508 Complex, the HASC, and the NRC. No significant impacts to land uses beneath these ranges are expected. Under the No-Action Alternative, no significant impacts to land use are expected.

Hazardous Materials and Hazardous Waste Management. F-22 program hazardous materials requirements and hazardous waste generation have been incorporated into the Hazardous Materials Distribution Support Center (HDSC) Operating Instruction and existing management programs at Edwards AFB. All F-22 program personnel will be trained in the use of the HDSC. No impacts to hazardous materials management or hazardous waste generation are expected at Edwards AFB. Ordnance associated with the F-22 aircraft would be handled in accordance with existing base procedures. Chaff and flare usage on the NRC would be conducted in approved areas where these activities routinely occur and in accordance with existing range procedures. No impacts from ordnance usage are expected. Under the No-Action Alternative, there would be no significant impacts to hazardous materials and hazardous waste management.

Air Quality. Air emissions from F-22 IOT&E activities at Edwards AFB would be de minimis; therefore, the Proposed Action would conform to the applicable SIP. Air emissions from engine test runs would occur within permitted sources at Edwards AFB. Airspace emissions in both the R-2508 Complex/HASC and the NRC would not hinder maintenance of air quality standards. Impacts on visibility in Class I areas would be insignificant. No significant air quality impacts would be expected. Under the No-Action Alternative, no significant air quality impacts are anticipated.

Noise. Noise from F-22 start-up and taxiing activities could exceed the nonoccupational exposure levels of 90 decibels A-weighted (dBA) in nonsecured areas adjacent to the F-22 CTF at Edwards AFB. However, these noise levels would not exceed the limiting exposure time of 1 hour. The F-22 CTF facilities were formerly utilized by F-15s, which are now stationed at another location at Edwards AFB. Noise levels at the F-22 CTF would be similar to those that were

produced at that site when the F-15s were stationed there. Engine test activities would occur in facilities distant from other facilities; noise levels would be similar to existing conditions at these locations. In addition, F-22 overflight noise levels and sonic boom intensities would be within the range of existing conditions in the R-2508 Complex, the HASC, and the NRC. No significant impacts to the noise environment would be expected. Under the No-Action Alternative, no significant impacts to the noise environment are anticipated.

Biological Resources. The Proposed Action would not present the potential for any impacts to vegetation beneath the R-2508 Complex and the HASC. Use of flares presents the potential for fire, which could affect vegetation beneath the NRC; however, observance of restrictions on the use of flares would minimize this risk. F-22 overflights would occur at altitudes that should not result in startle effects to wildlife from visual stimuli. Noise levels and sonic boom intensities would remain within existing levels on the ranges, and wildlife normally habituate to these noise levels. No significant impacts to biological resources are expected. Under the No-Action Alternative, no significant impacts to biological resources would be expected.

Cultural Resources. Noise from F-22 overflights and sonic booms could affect historic resources beneath the R-2508 Complex, the HASC, and the NRC. These noise levels and sonic boom intensities would be within the range of existing condition experiences on these ranges. Consultation with Native American groups will be conducted to ensure that Native American concerns regarding traditional cultural resources are addressed. No significant impacts to cultural resources are expected. Under the No-Action Alternative, no significant impacts to cultural resources would be expected.

3.0 AFFECTED ENVIRONMENT

This chapter describes the existing environmental conditions at Edwards and Nellis AFBs and their associated airspace complexes. The environmental components addressed include relevant natural or human environments that are likely to be affected by the Proposed Action.

Based upon the nature of activities that would occur under the Proposed Action, it was determined that the potential exists for the following resources to be affected: land use, airspace, hazardous materials and hazardous waste management, air quality, noise, biological resources, and cultural resources.

3.1 LAND USE

Land use can be defined as the human use of land resources for various purposes including economic production, natural resources protection, or institutional uses. Land uses are frequently regulated by management plans, policies, ordinances, and regulations that determine the types of uses that are allowable or protect specially designated or environmentally sensitive uses. Potential issues typically stem from encroachment of one land use or activity on another, or an incompatibility between land uses that leads to encroachment.

The region of influence (ROI) for land use consists of the on-base areas at Edwards AFB and land areas beneath the R-2508 Complex, HASC, and NRC. This section describes the existing environment in terms of land use planning and land uses.

3.1.1 Edwards Air Force Base

The ROI for land use at Edwards AFB encompasses the area within the base boundaries that may be affected by F-22 activities, as well as all land areas beneath the R-2508 Complex and HASC.

Land Use Plans

In 1990, due to the scattered urban development surrounding the base, DOD proposed that representatives of cities and counties surrounding the base develop methods to provide for compatible land use within those areas adjacent to and affected by base activities. The result was the Edwards Air Force Base Joint Land Use Study (City of Lancaster, 1994), which identifies coordinated future plan policies and recommendations within the incorporated cities of California City and Lancaster and the counties of Los Angeles, Kern, and San Bernardino for the area around Edwards AFB. Maintaining existing and ensuring future compatibility between the off-base community development and the mission activities of Edwards AFB is of primary concern. Policies that promote this relationship have

been incorporated into the long-term planning documents, zoning maps, and ordinances of these jurisdictions.

A committee of base personnel meets regularly to discuss proposed off-base projects that have the potential to encroach on base activities, such as housing subdivisions or telecommunications towers. Recommendations of the committee are coordinated with the jurisdiction for which the project is proposed.

In addition, the base is coordinating with the Bureau of Land Management (BLM), USFWS, and Kern and San Bernardino counties in a program to trade privately owned, rural parcels with publicly owned parcels closer to existing urban centers. This program is intended to facilitate conservation of the off-base desert tortoise habitat and to reduce the number of scattered housing parcels situated within the off-base overflight areas.

On-Base Land Use

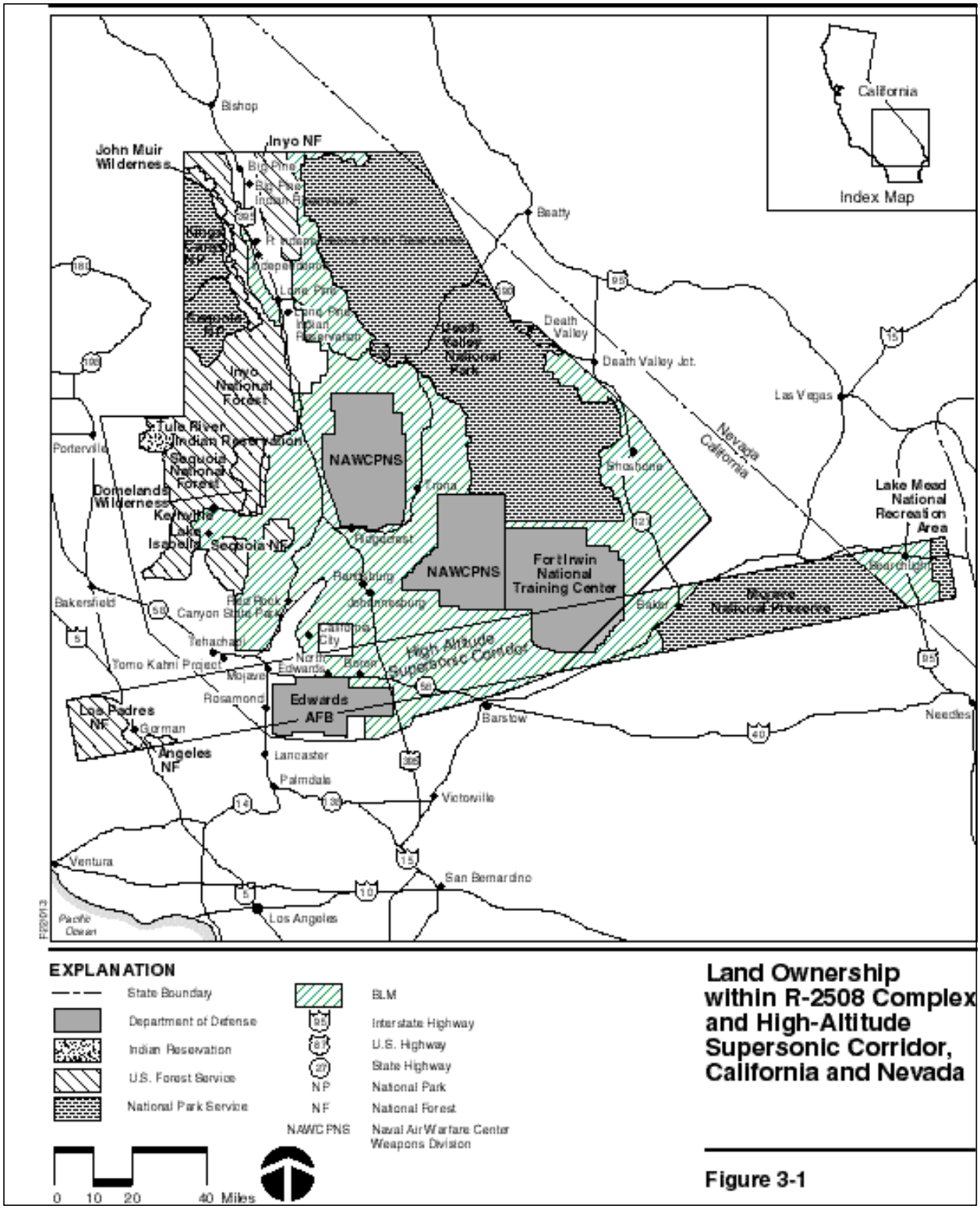
Edwards AFB is situated in Kern, Los Angeles, and San Bernardino counties, approximately 100 miles north of the city of Los Angeles. The base consists of approximately 301,000 acres of largely undeveloped or semi-improved land that is used predominantly for aircraft test ranges and maintained and unmaintained landing sites (i.e., dry lake beds). According to the 1994 Base Comprehensive Plan, the developed portion of the base includes approximately 6 percent of the total base area and is concentrated on the west side of Rogers Dry Lake. It includes North Base, South Base, Main Base, and Family Housing areas. Land uses associated with this area include airfield clearance, airfield pavement, aircraft operations and maintenance, engineering test, industrial, administrative, community commercial, community service, medical, accompanied and unaccompanied housing, outdoor recreation, and buffer zones. In addition, Air Force Research Lab, situated in the eastern portion of the base, includes a small developed area primarily used for administration, engineering, and testing related to rocket and propellant research, and community commercial uses (Edwards Air Force Base, 1994).

Existing land uses in the vicinity of the F-22 CTF, as identified in the base comprehensive plan, are aircraft clearances; airfield pavement, runways, and aprons; labeled painted runways; labeled nonmaintained landing site; engineering and testing; aircraft operations and maintenance; industrial use; and buffer zones (Edwards Air Force Base, 1994).

Airspace Complex Land Use

The R-2508 Complex encompasses large portions of Inyo, Kern, San Bernardino, and Tulare counties in east-central California. It also includes a portion of Fresno and Los Angeles counties in California and extends into Nevada's Esmeralda County (see Figure 1-1). Major communities beneath the R-2508 Complex include Lone Pine (population approximately 1,810), Tehachapi (5,800), Ridgecrest (27,700), Rosamond (7,430), Mojave (3,760), California City (5,960), Boron

(2,100), North Edwards (1,259), Lake Isabella (3,323), and Kernville (1,656) (Figure 3-1) (Rand McNally and Company, 1996).



Land Ownership within R-2508 Complex and High-Altitude Supersonic Corridor, California and Nevada

Figure 3-1

Edwards AFB is within the land area overlain by the R-2508 Complex. In addition to Edwards AFB, military land use areas beneath the R-2508 Complex include the NAWCPNS and the Army's Fort Irwin National Training Center. Portions of the Sequoia and Inyo national forests and Death Valley, Sequoia, and Kings Canyon national parks are situated beneath the R-2508 Complex. State-owned areas include Red Rock Canyon State Park and the Tomo Kahini Project. Areas of private land are primarily concentrated in the Owens Valley (Big Pine, Independence, and Lone Pine areas) and in the area that extends northwest from the western and northwestern boundary of Edwards AFB to the Porterville area. This includes Rosamond, Mojave, and Tehachapi, and land south and west of the national forests situated beneath the southwestern part of the R-2508 Complex (National Geographic Society, 1982). Native American land use areas include the Tule River Indian Reservation and three small Indian reservations at Big Pine, Lone Pine, and Fort Independence. The majority of the remaining land areas beneath the R-2508 Complex are controlled by the BLM (National Geographic Society, 1982).

The HASC extends from Ventura County, California, in the west, to Clark County, Nevada, in the east. It passes through portions of Kern, Los Angeles, and San Bernardino counties in California, and overlaps the R-2508 Complex in the vicinity of Edwards AFB (see Figure 1-1). Land uses within the portion of the HASC west of the R-2508 Complex include portions of the Los Padres and Angeles national forests and an area of primarily private land in the Tehachapi Mountains and Antelope Valley areas. The eastern portion of the HASC crosses the Mojave National Preserve in California and terminates over the Lake Mead National Recreation Area in Nevada; both are administered by the National Park Service. The remaining land areas within the eastern portion of the HASC are primarily BLM-owned lands in California and Nevada.

Land adjacent to Edwards AFB is predominantly arid desert with scattered urban and rural communities (Edwards Air Force Base, 1994). National forests are primarily situated on mountainous terrain in the Sierra Nevada. National forest land uses include timber production, grazing, recreation, and wildlife habitat. BLM lands are generally in more arid areas east and south of the Sierra Nevada. BLM land uses include grazing, mining, recreation, and wildlife habitat, such as the desert tortoise area described under Land Use Plans earlier in this section. National and state parks are primarily recreational and wildlife habitat areas. BLM, national park, and national forest lands include designated wilderness areas. In addition to the recreational land uses on public lands, recreational land use areas include the Lake Isabella area. Private land uses in this area include populated areas and agricultural/ranching land uses. Some chemical and mineral extraction activities also occur in the area (e.g., Boron, Trona).

Areas of land use concern with respect to noise include the Black Mountain Supersonic Corridor and other areas north of Edwards AFB. Housing has been developed north of Edwards AFB, creating a potentially noise-sensitive area. As previously described, a 1994 joint land use study has prompted a concerted effort in planning compatible land uses for those areas affected by Edwards AFB

activities. In addition, there are a number of noise-sensitive areas in Death Valley and Sequoia/Kings Canyon national parks, as well as in designated wilderness areas.

3.1.2 Nellis Range Complex

The ROI for land use encompasses all land areas that are situated beneath the NRC.

Land Use Plans

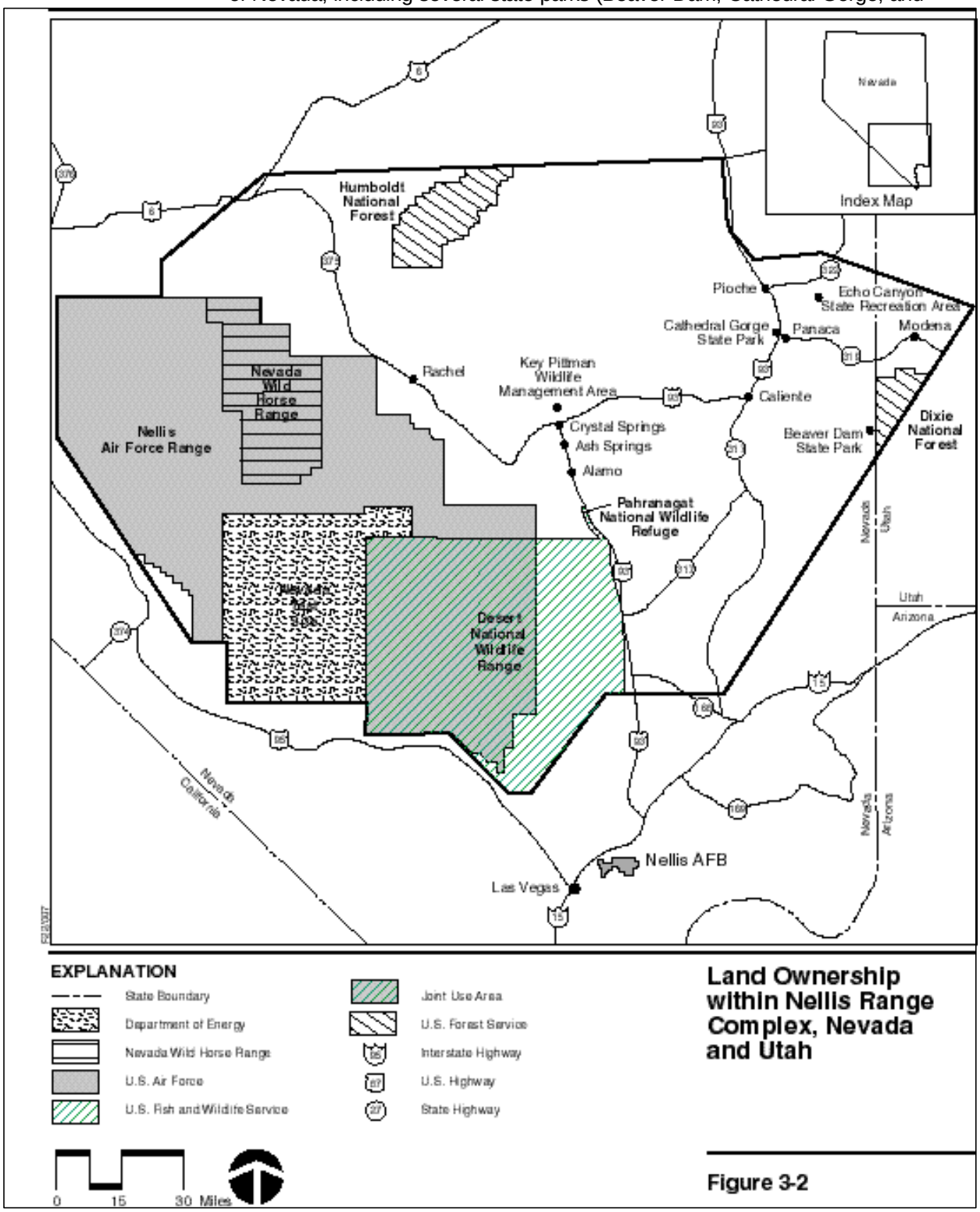
The majority of the land beneath the NRC is under federal management by the Nellis Air Force Range (NAFR), the Department of Energy (DOE), USFWS, U.S. Forest Service, and the BLM (Figure 3-2). These areas are managed for continued use as specified under Airspace Complex Land Use.

Airspace Complex Land Use

The NRC overlays large portions of Clark, Lincoln, and Nye counties in southern Nevada and small portions of Iron and Washington counties in southwest Utah (see Figure 1-2). Land uses in this area include the military land use area of the NAFR. The NAFR consists of approximately 3 million acres. The majority of the NAFR consists of lands withdrawn from the BLM. Withdrawn lands refers to land which is set aside for a specific use. In this case, it is land that has been set aside for military use that is not available for public use. It remains under the jurisdiction and management of the agency that is responsible for the land. The Air Force must comply with all uses, policies, programs, federal requirements as mandated and administered through BLM. The 389,420-acre Nevada Wild Horse Range is included in the NAFR and is administered by the BLM. Approximately 816,400 acres of the NAFR have been withdrawn from the Desert National Wildlife Range (DNWR). The Air Force and USFWS jointly manage this area. The Nevada Test Site, administered by the DOE, is contiguous with the NAFR in the southwestern part of the NRC. Public access to the NAFR and the Nevada Test Site is highly restricted, although some areas support grazing leases (U.S. Air Force, 1994a). The NAFR is used for training, testing, and weapons evaluation operations for the Air Force, Army, Marine Corps, National Guard, Navy, DOE, and reserve forces. Target complexes with bombing circles and triangles, and simulated runways, airfields, and convoys are situated on parts of the NAFR (Nellis Air Force Base, 1997).

The major land uses beneath the remainder of the NRC area are managed by the BLM and are primarily used for the production of cattle and other livestock. This rural area is scattered with widely separated small communities, farms, and ranches (U.S. Air Force, 1994a). Limited private land area also occurs within this portion of the NRC. Communities within the area include Pioche (population approximately 800), Alamo (400), and Caliente (1,100) within Nevada, and Modena (35) in Utah (Rand McNally and Company, 1996; U.S. Air Force, 1994a).

Portions of the Humboldt National Forest in Nevada and the Dixie National Forest in Utah are also situated within this area. Some areas are controlled by the state of Nevada, including several state parks (Beaver Dam, Cathedral Gorge, and



Echo Canyon). State parks and BLM recreational sites support recreational land uses. The Humboldt National Forest area within the boundaries of the NRC includes the Quinn Canyon and Grant Range wilderness areas.

Approximately 18 wildlife resource areas and national wildlife refuge (NWR) system units are either totally or partially beneath the NRC. These areas are administered by three agencies: the USFWS manages approximately 1.26 million acres, the U.S. Forest Service manages approximately 57,000 acres, and the BLM manages 927,503 acres, totaling approximately 2.24 million acres, or approximately 17 percent of the total NRC (U.S. Air Force, 1994). The two major NWR system units are the DNWR, partially overlapping with the NAFR, as described earlier, and the Pahranagat NWR.

3.2 AIRSPACE

Airspace is a finite resource that can be defined vertically, horizontally, and temporally, when describing its use for aviation purposes. As such, it must be managed and utilized in a manner that best serves the competing needs of commercial, general, and military aviation interests. The amount of airspace activity that can be effectively managed is governed by the safety procedures, tracking system capabilities, and level of aviation activity associated with the airspace. The first two factors are usually inflexible, but the third, level of aviation activity, can be managed. The level of long-term airspace activity allowed is generally based on historic data and is referred to as the airspace utilization baseline, which is composed of a commercial and general aviation component and a military aviation component. The FAA manages commercial and general aviation activity within the airspace, and the military manages the military aviation activity with FAA oversight. Historic military aviation activity is based on two elements: host base activity and transient aircraft activity. Host base activity is generated by the aircraft assigned to the installation. That activity includes its primary mission, such as training or testing, and, its other missions, which include various types of support operations. Those support operations can range from providing planes to support DT&E and OT&E tests to emergency support. Transient aircraft activity is generated by aircraft assigned to other Air Force installations, other DOD services, and other government agencies that use the airspace. Transient activity may be single transits or reoccurring transits through the airspace.

The ROI for airspace includes those areas that would be utilized by F-22 IOT&E flights. F-22 IOT&E testing is proposed for special use airspace under the control of both Edwards and Nellis AFBs. A description of special use airspace is presented in Appendix B.

3.2.1 Edwards Air Force Base

The airspace ROI associated with Edwards AFB includes the R-2508 Complex, the Black Mountain Supersonic Corridor, and the HASC.

Edwards AFB has a bird-air strike hazard program to assist pilots in preventing bird strikes on aircraft as addressed in AFI 91-202, U.S. Air Force Mishap Prevention Program. The program calls for modifications to operations according to birdwatch threat conditions (Air Force Flight Test Center, 1998). The base also has a foreign object damage program to prevent damage to aircraft as addressed in AFI 21-101, Maintenance Management of Aircraft.

R-2508 Complex Airspace. The AFFTC at Edwards AFB is primarily tasked with testing manned and unmanned prototype and experimental aerospace vehicles in support of the Air Force mission (U.S. Air Force, 1995b). The R-2508 Complex airspace utilized by the AFFTC and other DOD users was established for the purpose of accomplishing subsonic and supersonic flight test mission operations necessary to evaluate the total integrated systems and subsystems of prototype and experimental aerospace vehicles.

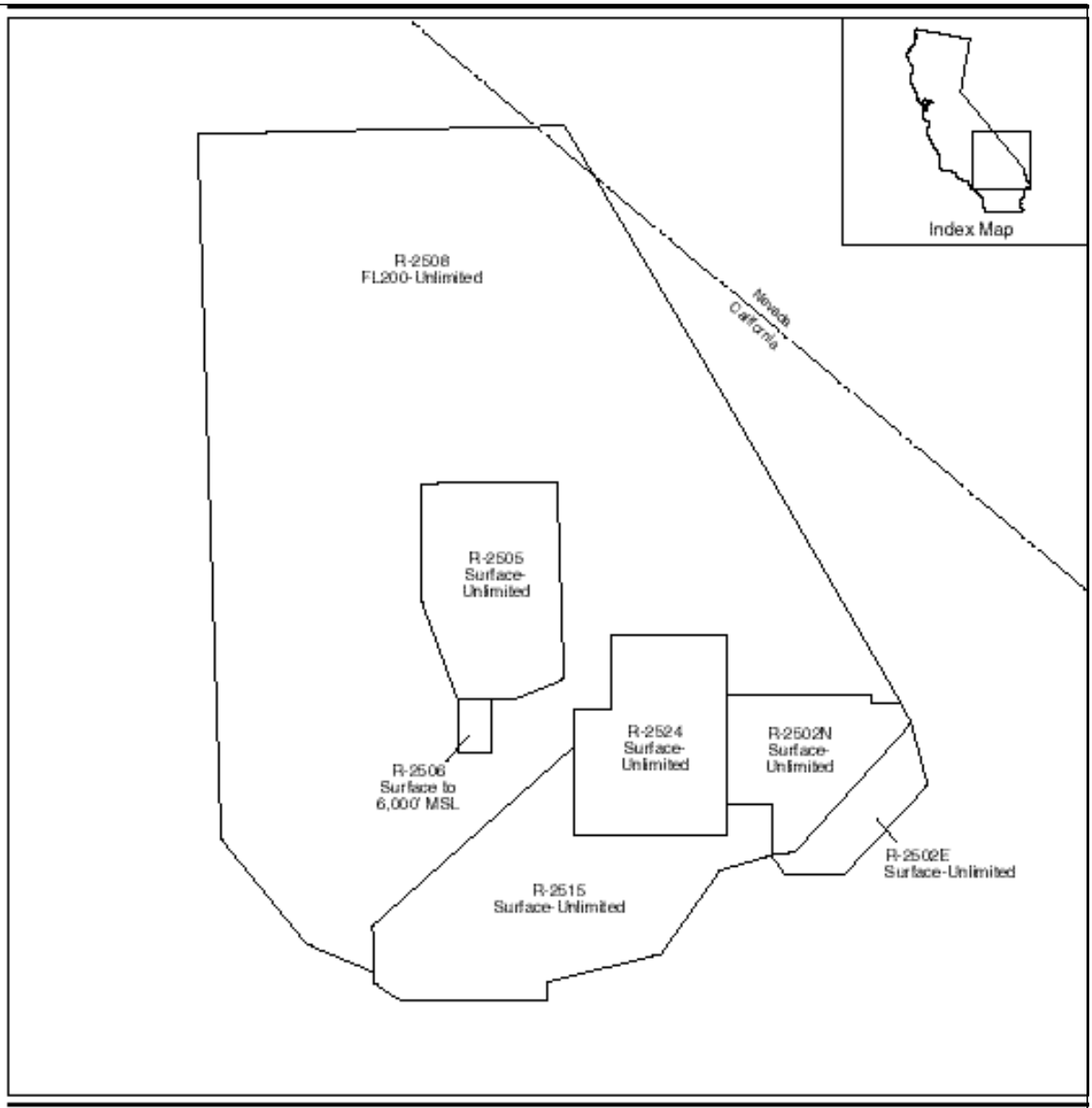
Management of the R-2508 Complex is the responsibility of the R-2508 Joint Policy and Planning Board (JPPB). JPPB members are the Commanders of the NAWCPNS; AFFTC, Edwards AFB; and Fort Irwin National Training Center. The mission of the JPPB is to enhance and preserve the R-2508 Complex bases, ranges, and special use airspace; and to increase DOD capability for research, development, testing, and evaluation of aircraft and weapons systems. Additionally, the JPPB preserves an area for operational training and readiness of DOD-sponsored activities (R-2508 Complex Control Board, 1997).

The R-2508 Complex Control Board conducts day-to-day management of the R-2508 Complex management function. The R-2508 Central Coordinating Facility, under direction of the Complex Control Board, is the designated scheduling authority for R-2508 Complex shared-use airspace (R-2508 Complex Control Board, 1997).

Airspace utilization within the R-2508 Complex is monitored and controlled by the Hi Desert Terminal Radar Approach Control (TRACON), an FAA facility on Edwards AFB, to assure that operations are contained within the designated airspace, and that operations are carried out in accordance with published procedures. These procedures, which outline specific requirements of the FAA and the aircrews involved in operations within the R-2508 Complex, are published in Letters of Agreement between the FAA and the AFFTC. AFFTC Instruction 11-1 also identifies the locations and restrictions applicable to low-altitude avoidance and noise-sensitive areas within the R-2508 Complex.

The R-2508 Complex airspace consists of 7 Restricted Areas, 10 MOAs, and 14 ATCAAs (Figures 3-3, 3-4, and 3-5). Restricted Areas within the R-2508 Complex consist of five areas (R-2502E, R-2502N, R-2505, R-2515, and R-2524) that extend from the ground surface to unlimited altitude; one area (R-2506) that extends from the surface to 6,000 feet above MSL, and the R-2508 Restricted Area, which extends from 20,000 feet above MSL to unlimited height and consists of the airspace found within the Isabella, Panamint, Saline, and Owens ATCAAs (Table 3-1).

The MOAs within the R-2508 Complex include the Isabella, Owens, Saline, Panamint, Barstow, Buckhorn, Bishop, and Shoshone MOAs, which have lower boundaries of 200 feet AGL, and the Bakersfield and Porterville MOAs, which



EXPLANATION

———	State Boundary
FL	Flight Level (in hundreds of feet)
MSL	Above Mean Sea Level
R	Restricted Area

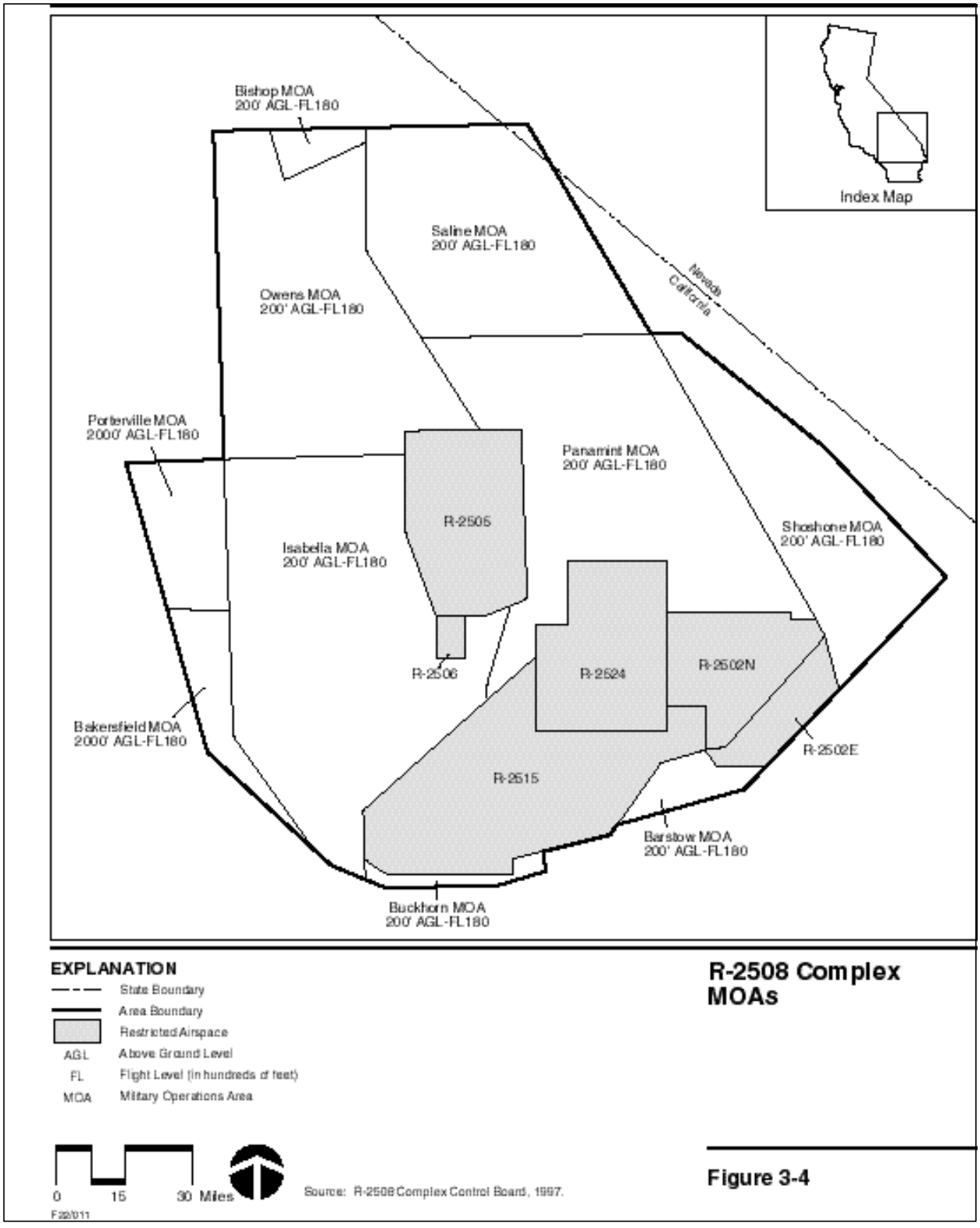
R-2508 Complex Restricted Areas

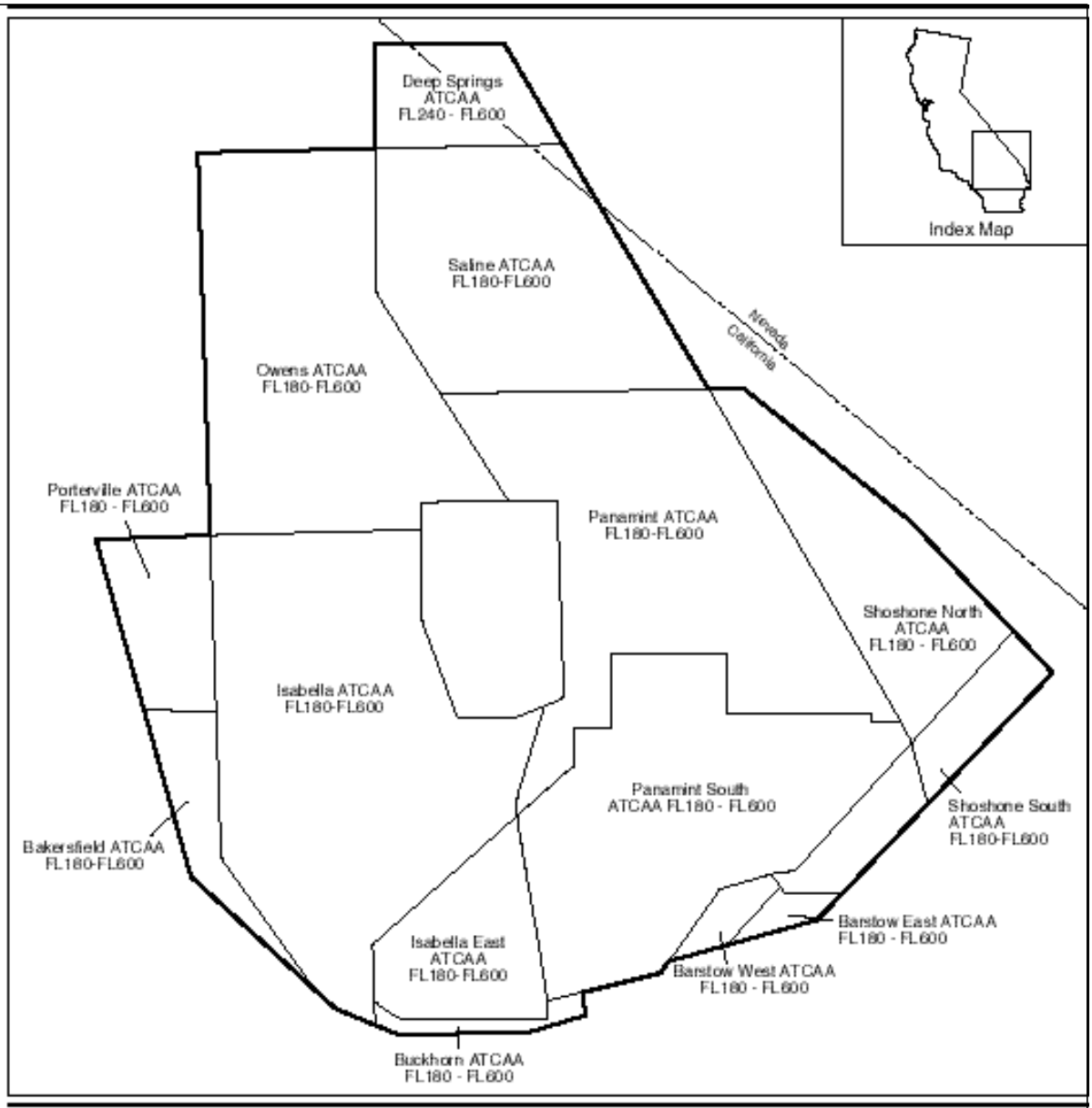
0 15 30 Miles

F22012

Source: R-2508 Complex Control Board, 1997.

Figure 3-3


Bishop MOA
200' AGL-FL180
Saline MOA
200' AGL-FL180
Owens MOA
200' AGL-FL180
Nevada
California
Index Map
Porterville MOA
200' AGL-FL180
Panamint MOA
200' AGL-FL180
R-2505
Shoshone MOA
200' AGL-FL180
Isabella MOA
200' AGL-FL180
R-2506
R-2524
R-2502N
R-2502E
Bakersfield MOA
200' AGL-FL180
R-2515
Barstow MOA
200' AGL-FL180
Buckhorn MOA
200' AGL-FL180
EXPLANATION
State Boundary
Area Boundary
Restricted Airspace
AGL Above Ground Level
FL Flight Level (in hundreds of feet)
MOA Military Operations Area
0 15 30 Miles
Source: R-2508 Complex Control Board, 1997.
F22/011
R-2508 Complex MOAs
Figure 3-4



EXPLANATION

- State Boundary
- Area Boundary
- AGL Above Ground Level
- FL Flight Level (in hundreds of feet)
- ATCAA Air Traffic Control Assigned Airspace

0 15 30 Miles

Note: Deep Springs ATCAA not included in the airspace ROI.

Source: R-2508 Complex Control Board, 1997.

F22/027

R-2508 Complex ATCAAs

Figure 3-5

Table 3-1. R-2508 Complex - Restricted Areas

Number	Location (California)	Altitude	Time of Use	Controlling Agency (Edwards AFB)
R-2502E	Fort Irwin	Unlimited	Continuous	Hi Desert TRACON
R-2502N	Fort Irwin	Unlimited	Continuous	Hi Desert TRACON
R-2505	China Lake	Unlimited	Continuous	Hi Desert TRACON
R-2506	China Lake South	To 6,000 feet above MSL	Sunrise to sunset, Monday through Friday	Hi Desert TRACON
R-2508	Mojave Desert	From 20,000 feet above MSL to unlimited	Continuous	Hi Desert TRACON
R-2515	Muroc Lake	Unlimited	Continuous	Hi Desert TRACON
R-2524	Trona	Unlimited	Continuous	Hi Desert TRACON

AFB = Air Force Base
MSL = mean sea level
TRACON = Terminal Radar Approach Control

Source: National Oceanic and Atmospheric Administration, 1997a.

have lower boundaries of 2,000 feet AGL (Table 3-2). The MOA airspace over wilderness areas, national parks, and national monuments (using 1977 boundaries) is restricted to above 3,000 feet AGL. The MOAs all extend up to, but do not include, 18,000 feet above MSL.

Table 3-2. R-2508 Complex - Military Operations Areas

Name	Altitude of Use (feet)[(a)](AGL)	Time of Use[(b)]	Controlling Agency
Bakersfield	2,000	0600-2200 Monday-Friday	ZLA Center
Bishop	200	0600-2200 Monday-Friday	ZLA Center or Edwards AFB RAPCON
Barstow	200	0600-2200 Monday-Friday	Hi Desert TRACON, Edwards AFB
Buckhorn	200	0600-2200 Monday-Friday	ZLA Center
Isabella	200	0600-2200 Monday-Friday	Hi Desert TRACON, Edwards AFB
Owens	200	0600-2200 Monday-Friday	Hi Desert TRACON, Edwards AFB
Panamint	200	0600-2200 Monday-Friday	Hi Desert TRACON, Edwards AFB
Porterville	2,000	0600-2200 Monday-Friday	ZLA Center
Saline	200	0600-2200 Monday-Friday	Hi Desert TRACON, Edwards AFB
Shoshone	200	0600-2200 Monday-Friday	ZLA Center

Notes: (a) Altitudes indicate floor of MOA. All MOAs extend to, but do not include, Flight Level 180 (18,000 feet above mean sea level).
(b) Other time by NOTAM; contact FSS.
AGL = above ground level
FSS = Flight Service Station
MOA = Military Operations Area
NOTAM = Notice to Airmen
RAPCON = Radar Approach Control
TRACON = Terminal Radar Approach Control
ZLA = Los Angeles

Source: National Oceanic and Atmospheric Administration, 1997a.

The Isabella, Panamint, Saline, and Owens ATCAAs lie between 18,000 and 60,000 feet above MSL; however, these ATCAAs end at 20,000 feet above MSL when the R-2508 Restricted Area is active. The four ATCAAs fill in the airspace gap between the top of the MOAs (18,000 feet MSL) and the bottom of the R-2508 Restricted Area (20,000 feet MSL) when it is active. ATCAAs above the peripheral MOAs that are outside the lateral boundaries of the R-2508 Restricted Area (Porterville, Bakersfield, Buckhorn, Barstow West, Barstow East, Shoshone South, and Shoshone North ATCAAs) afford additional areas up to 6,000 feet above MSL for segregation of military operations from instrument flight rules traffic. The Isabella East and Panamint South ATCAAs are set up within the boundaries of the R-2515, R-2502N, R-2502E, and R-2524 restricted areas for ATC and for military operations when restricted areas are not active. The Deep Springs ATCAA consists of airspace from 2,400 feet above MSL to 6,000 feet above MSL.

This ATCAA does not overlie an MOA and is not considered as part of the R-2508 Complex ROI in this EA because it would not be used in support of F-22 IOT&E flight activities.

Airspace access is obtained by contacting Hi Desert TRACON at Edwards AFB. Civilian aircraft may travel through restricted airspace only after receiving permission from the Hi Desert TRACON. All civilian and nonparticipating military aircraft are generally prohibited from flying through restricted airspace during military training exercises. Prior to entering an MOA, the pilot of a civilian aircraft would typically contact the Hi Desert TRACON, the nearest Flight Service Station, or an ATC facility to obtain the current Notice to Airmen (NOTAM) on military activity within the MOAs. Civilian flights through MOA airspace, after receiving the latest NOTAM, are generally allowed to transit the MOA with see-and-avoid responsibility.

The R-2508 Complex is managed in accordance with a shared use agreement among Edwards AFB, NAWCNPS, Air Force Plant 42 in Lancaster, and Fort Irwin National Training Center. Prior approval for shared use of the R-2508 Complex is not required except for specific restricted areas within the R-2508 Complex. The shared areas are primarily used for nonhazardous test activities and Air Force Test Pilot School training (U.S. Air Force, 1995b).

Operations in the R-2508 Complex ranged from approximately 70,000 to 90,000 sorties per year in the late 1980s and early 1990s (U.S. Air Force, 1984). The reduction in military activity following the end of the Cold War has reduced overall activity in the R-2508 Complex (U.S. Air Force, 1995b). The aircraft operations over the R-2508 Complex include missions from Edwards AFB, other air bases, and civilian bases. The major user is the 412th Test Wing, which consists of several squadrons that execute the test and evaluation of various aircraft. Additionally, the U.S. Air Force Test Pilot School, National Aeronautics and Space Administration (NASA), NAWCPNS, Point Mugu Naval Air Station, Lemoore Naval Air Station, and other military and civilian organizations utilize the range. A total of 54,188 sorties were reported in 1993; 13,823 of these originated from Edwards AFB. Ninety-five percent of Edwards AFB sorties occurred in the daytime.

Another 74,000 annual operations by Army rotary wing aircraft use the range during training exercises. Aircraft generally flown in the R-2508 Complex include the following:

A-4	A-6	A-10	A-37	AH-1	AV-8B
B-1B	B-2	B-52	C-17	C-23A	C-130
C-141	EA-6B	F-4	F-14	F-15	F-16
F-18	F-22	F/A-18A	KC-10	KC-135	Metroliner
SR-71	T-34	T-38	T-39	UH-1N	X-36

(U.S. Army Corps of Engineers et al., 1997).

Black Mountain Supersonic Corridor. The Black Mountain Supersonic Corridor is about 10 miles northeast of Edwards AFB (Figure 3-6). It is contained within Restricted Airspaces R-2508 and R-2515 (see Figure 2-4) and has been set aside by the FAA for supersonic aircraft research, development, testing, and evaluation (U.S. Air Force, 1995b).

The Black Mountain Supersonic Corridor is an elongated test area 9.2 miles wide by 55.2 miles long, extending down to 500 feet AGL. Border coordinates are from N35 08 minutes (') latitude to N35 16' latitude, and from W116 49' longitude on the eastern end with a base of 500 feet AGL, to W117 45' longitude with a base of 10,000 feet above MSL, and to W117 57' longitude with a base of 30,000 feet above MSL. There is no upper altitude limit to this corridor. A circular area on the southern boundary immediately north of Harpers Lake, including the Black Mountain and Opal Mountain areas, accommodates supersonic turns or maneuvers. The extreme southern limit of the circular area is N35 02' latitude (U.S. Air Force, 1995b).

For operations between 500 feet AGL to 10,000 feet above MSL, the Black Mountain Supersonic Corridor provides approximately 44 miles of useable east-west supersonic area. For operations between 10,000 feet and 30,000 feet above MSL, the Black Mountain Supersonic Corridor provides approximately 53 miles of useable east-west supersonic area. Below 30,000 feet above MSL, the corridor is totally contained within Restricted Area R-2515. Above 30,000 feet above MSL, the western end extends approximately 12 miles into Restricted Area R-2508. The maneuvering area within the Black Mountain Supersonic Corridor area is about midway along the eastern end of the Corridor and extends 4.6 miles farther south than the rest of the southern boundary (U.S. Air Force, 1995b).

Between 1990 and 1994, an average of 200 flights per year were flown in the Black Mountain Supersonic Corridor. As many as 30 supersonic mission activities are accommodated in the Corridor flights per day, depending upon the level of test operations. Most supersonic flight testing occurs between 8 a.m. and 5 p.m. In 1995, B-1, F-15, F-16, F-111, and T-38 aircraft used the Black Mountain Supersonic Corridor. Future use of the airspace by these aircraft is projected to decline due to future decreases in testing of current aircraft (U.S. Air Force, 1995b).

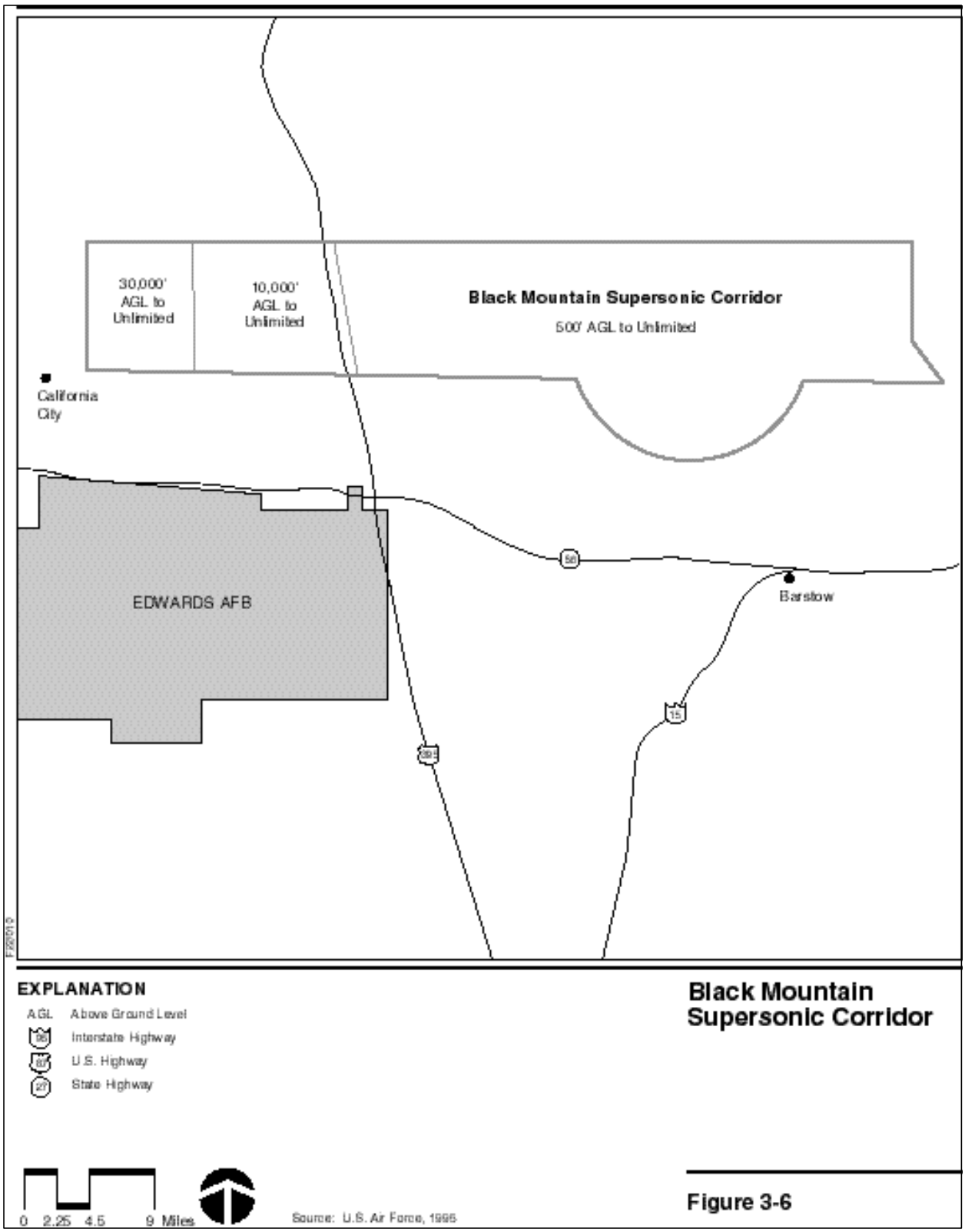

30,000' AGL to Unlimited
10,000' AGL to Unlimited
Black Mountain Supersonic Corridor
500' AGL to Unlimited
California City
EDWARDS AFB
58
Barstow
15
395
EXPLANATION
AGL Above Ground Level
Interstate Highway
U.S. Highway
State Highway
0 2.25 4.5 9 Miles
Source: U.S. Air Force, 1995
Black Mountain Supersonic Corridor

Figure 3-6

High-Altitude Supersonic Corridor. The HASC is a rectangular area extending between Lake Mojave on the Colorado River in Nevada and Mount Pinos south of Bakersfield, California (see Figure 1-1). The corridor is 15 nm wide and 224 nm long beginning at 30,000 feet above MSL and extending upward to an unlimited altitude (U.S. Air Force, 1997c). Operations are conducted in accordance with a Letter of Agreement covering operational procedures between the AFFTC and the FAA, because the HASC extends east and west outside of restricted airspace and into the FAA's positive controlled airspace (U.S. Air Force, 1984). The HASC is utilized by the same types of aircraft as are used in the Black Mountain Supersonic Corridor.

3.2.2 Nellis Range Complex

The ROI for airspace also includes the NRC, which encompasses approximately 12,000 sq nm. The complex is composed of both land and airspace components. The airspace components include the Reveille MOA, the Desert MOA, and a number of restricted areas (Figure 3-7). Desert MOA is divided into five subdivisions: Coyote, Caliente, Cedar, Elgin, and Sally Corridor. The restricted areas include R-4806E, R-4806W, R-4807A, R-4807B, R-4808N, R-4808S, and R-4809. Restricted Areas R-4806 E & W, R-4807 A & B, and R-4809 are controlled by the Air Force, while R-4808 N and S are controlled by the DOE. DOE airspace over the Nevada Test Site (NTS); it is not part of the NRC, but its western portion is used by NRC aircraft to transit to and from the North Range. Through agreement with the DOE, NRC aircraft are able to use the western portion of this restricted airspace as a transit corridor between 14,000 and 27,000 feet MSL for entering and exiting the North Range. Nellis AFB has subdivided this restricted airspace into R-4808E/W to internally schedule and track aircraft operations through this airspace. Further internal subdivision of this restricted airspace is being coordinated with DOE to accommodate internal changes in the use and scheduling of these areas. These changes do not affect the purpose for which R-4808N/S was established, nor do they affect surrounding airspace uses. The ground components of the NRC underlie the restricted airspace and include a number of ranges used for air-to-ground gunnery and weapons delivery. Users of the NRC include the Army, Navy, Marines, Air National Guard, and Air Force Reserve, as well as foreign military units (U.S. Air Force, 1994a).

Operations. A combination of Air Force and FAA rules and regulations governs the use of the NRC airspace. The NRC Air Traffic Control Facility (NATCF) manages the NRC airspace by Letter of Agreement with the Los Angeles ATC Center. Airspace access is obtained by contacting the NATCF at Nellis AFB. Civilian aircraft may travel through a restricted airspace only after receiving permission from the NATCF. All civilian and nonparticipating military aircraft are generally prohibited from flying through restricted airspace during military training exercises. Prior to entering an MOA, the pilot of a civilian aircraft would typically contact the NATCF, the nearest Flight Service Station, or an ATC facility to obtain the current NOTAM on military aircraft activity within the MOAs. After receiving the latest NOTAM, civilian flights through MOA airspace are generally allowed to

transit the MOA with see-and-avoid responsibility (U.S. Air Force, 1994a). Military flight operations conducted within the NRC are in part governed by the Nellis AFB

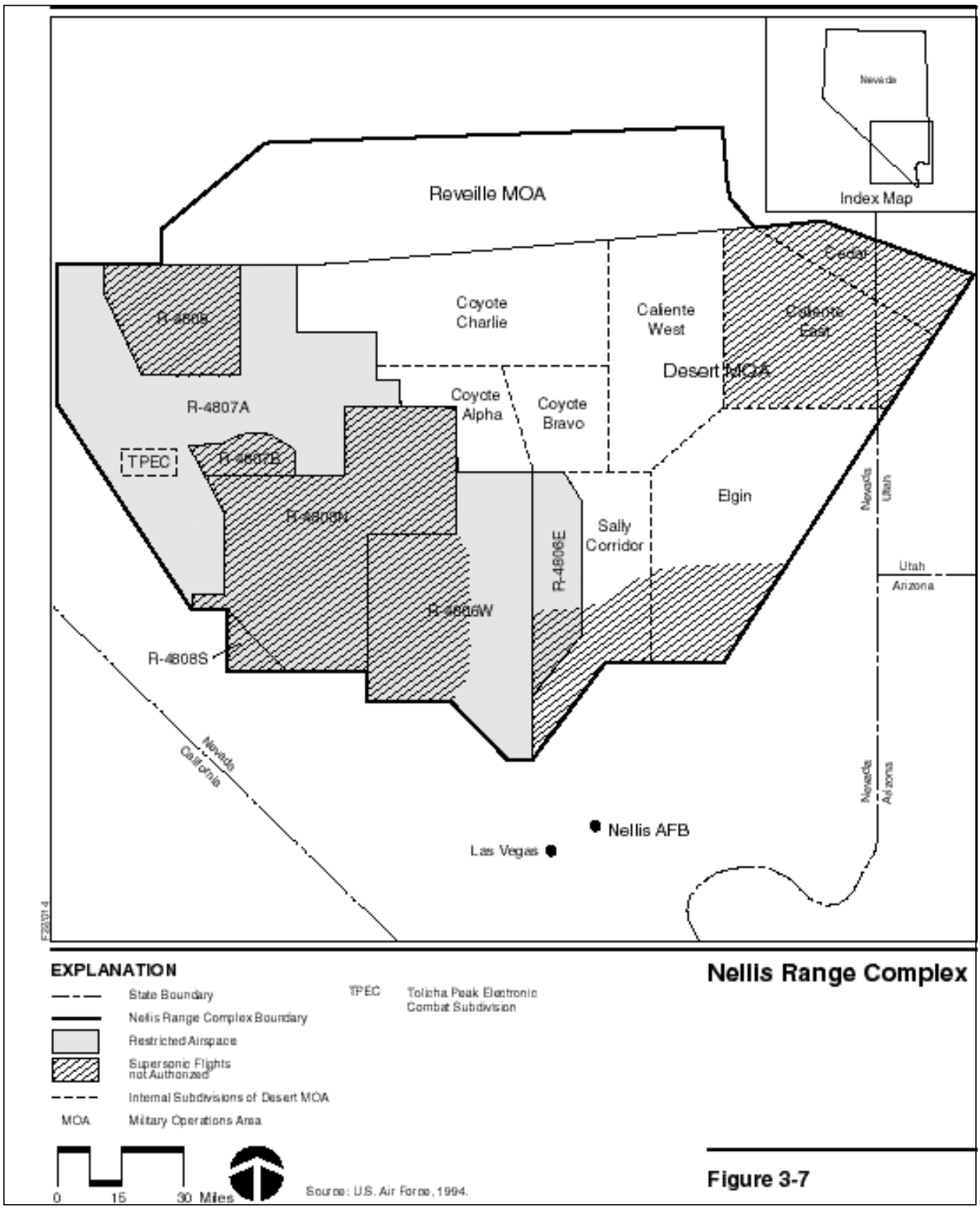

Nevada
Index Map
Reveille MOA
Coyote Charlie
Caliente West
Cedar
Caliente East
Desert MOA
R-4805
R-4807A
Coyote Alpha
Coyote Bravo
TPEC
R-4807B
R-4808N
R-4806E
Sally Corridor
Elgin
Nevada
Utah
Utah
Arizona
R-4806W
R-4808S
Nevada
California
Nevada
Arizona
Nellis AFB
Las Vegas
F22IOT-4
EXPLANATION
State Boundary
Nellis Range Complex Boundary
Restricted Airspace
Supersonic Flights not Authorized
Internal Subdivisions of Desert MOA
MOA Military Operations Area
TPEC Tolicha Peak Electronic Combat Subdivision
0 15 30 Miles
Source: U.S. Air Force, 1994.
Nellis Range Complex

Figure 3-7

supplements to AFI 13-212 Volume l Weapons Ranges and Volume II Weapons Range Management. The supplement identifies restrictions on subsonic and supersonic operations, pinpoints the locations of and restrictions applicable to low-altitude avoidance areas and noise-sensitive areas.

Supersonic Flight. Supersonic flight is approved within certain designated airspace in the NRC based upon the requirements for realistic testing and training. Approximately 70 percent of the NRC airspace is authorized for supersonic flight. Supersonic flight is conducted only when necessary to accomplish the mission. Approximately 10 percent of the total flight time flown by aircraft capable of supersonic flight is actually flown at supersonic speed. Supersonic flights are recorded in accordance with AFI 13-201. Supersonic flights over populated areas and other noise-sensitive areas are avoided when these urban centers are below supersonic flight airspace. The following airspace or portions of airspace are approved for supersonic flight:

Reveille MOA:

- Reveille MOA, from 5,000 feet AGL to the maximum flight level scheduled.

Desert MOA:

- Caliente subdivision: the portion west of Longitude W114 35'; 5,000 feet AGL to unlimited altitude
- Coyote subdivision: the entire area; 5,000 feet AGL to unlimited altitude
- Sally Corridor subdivision: the portion north of Latitude N36 52', 5,000 feet AGL to unlimited altitude
- Elgin subdivision: the portion north of a line from Latitude N36 52', Longitude W114 50' 43 seconds (") to Latitude N37 04', Longitude W114 33' to Latitude N37 04" and Longitude W114 20'; 5,000 feet AGL to unlimited altitude.

Restricted Areas:

- R-4806E: the portion north of Latitude N36 52'; 5,000 feet AGL to unlimited altitude
- R-4806W: the eastern portion above 5,000 feet AGL to unlimited altitude
- R-4807A: above 100 feet AGL to unlimited altitude
- Tolicha Peak Electronic Combat subdivision of R-4807A: 5,000 feet AGL to unlimited altitude (U.S. Air Force, 1994a).

The major portion of supersonic flight within the NRC occurs between 5,000 feet AGL and an unlimited altitude. Supersonic flights are not authorized in most portions of R-4808 N and S and are not normally conducted in R-4809. Supersonic flights may be approved on a case-by-case basis within these areas after coordination with the Sandia Corporation, the manager of the DOE Nevada Nuclear Test Site. Once approved, supersonic flights may be conducted above 5,000 feet AGL in these areas. Other flight restrictions may apply and are conveyed at the time of approval (U.S. Air Force, 1994a).

Except for the extreme northern portions, all of R-4806E and R-4806W overlie the DNWR. The following special flight restrictions govern the use of these two areas within the July 1993 Memorandum of Understanding:

- Aircraft will remain above 2,000 feet AGL unless accomplishment of the mission specifically requires a lower altitude.

- Air-to-air gunnery operations will be conducted above 10,000 feet above MSL.

- No flights will be allowed below 2,000 feet AGL within 0.5 nm of wildlife watering points (as depicted on the NRC Chart as Noise Sensitive Areas) (U.S. Air Force, 1994a).

During the annual bighorn sheep hunt on the DNWR, the following restrictions apply to R-4806E, R-4806W, and the Sally Corridor subdivision of the Desert MOA:

- All flights will be above 15,000 feet above MSL in R-4806E and R-4806W.

- Flights in the Sally Corridor west of Longitude 115 will be above 15,000 feet AGL (U.S. Air Force, 1994a).

Supersonic flights in the NRC are conducted in restricted airspace and MOAs that have been selected, evaluated, and approved by the Air Force. The criteria and requirements used in the supersonic airspace selection include:

- Proximity to Base - Distance for optimum training value depends upon the mission and type of aircraft. The goal is to provide maximum on-range time for the least amount of fuel expended in transit.

- Land Use Density - The area selected has a low population density to limit the number of people who would be potentially affected.

- Civilian Air Traffic - The area has minimum or no civilian air traffic to ensure safe operations of training flights without potential conflict with civilian air traffic.

- Airspace Usage Schedule - Airspace scheduling by one command or service avoids flight and range scheduling conflicts between services. Efficient scheduling results in maximum use of airspace and enhanced safety for each training operation.

- Scheduling Priority - The primary user has scheduling priority. There are minimal flight delays en route, or while entering or exiting the airspace; this saves fuel and prevents excessive time in assigned airspace.

- Terrain Elevation - Ground elevation is preferably below 5,000 feet above MSL. This provides aircraft the largest maneuvering envelope. Elevations between 5,000 and 10,000 feet above MSL are acceptable, although they restrict certain flight operations. Ground elevations above 10,000 feet above MSL severely restrict flight operations. An area with high terrain elevation is generally not acceptable except as a secondary area for limited flight operations.

- Flight Ceiling - Depending upon mission requirements, the airspace ceiling is 50,000 feet above MSL or higher.

- Size - The optimum airspace size varies directly with mission and aircraft type. The airspace must be large enough to accommodate as many different types of aircraft as possible.

- Noise - The airspace is not situated over noise-sensitive areas such as large urban centers, highly populated areas, hospitals, schools, scenic areas, or high-use recreational areas (U.S. Air Force, 1994a).

Airspace Usage. Airspace usage within the NRC is tracked by sortie operations. Whereas a sortie entails one aircraft mission from takeoff to landing, a sortie operation represents the use of one airspace unit (i.e., MOA, restricted area, or subsection of a restricted area) by one aircraft. One F-22 IOT&E sortie may account for up to 10 to 12 sortie operations within the NRC, but the F-15C averages 6 sortie-operations per sortie. Recent historical usage of the NRC has ranged from 200,000 to 300,000 sortie operations. Approximately 70 percent of these sortie operations are flown by F-15 and F-16 aircraft (U.S. Air Force, 1998).

Most supersonic flights are currently conducted by F-14, F-15, F-16, and F/A-18 aircraft. Approximately 10 percent of the total flight time logged by these aircraft involves supersonic flight, with aircraft obtaining supersonic speed for a brief period during the sortie. Approximately 5 percent of the supersonic flight time occurs during acoustical night, between 10 p.m. and 7 a.m.

The ground targets below the four restricted areas have a wide variety of target installations for the delivery of air-to-ground weapons. Live and inert ordnance, ammunition, flares, and rockets are expended from the air-to-ground weapons systems. Several of the target ranges are manned for evaluation and scoring of weapons delivery accuracy. Some target ranges are used for bombing and utilize a variety of electronic warfare scenarios and radar-guided delivery systems.

Additionally, the target ranges below the restricted areas are used for testing and evaluating new weapons systems. The two MOAs are used for a variety of aircraft operations but do not include deployment of any munitions, ordnance, or release of other weapons (U.S. Air Force, 1994a).

3.3 HAZARDOUS MATERIALS AND HAZARDOUS WASTE MANAGEMENT

Management of hazardous materials and hazardous waste is governed by specific environmental regulations. For purposes of this analysis, hazardous materials and hazardous waste are those substances defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. Sections 9601, et seq., as amended, and the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. Sections 6901-6992, as amended. In general, this includes substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may present substantial danger to public health or welfare or the environment when released. State regulations must be at least as stringent as the federal regulations. Additionally, Executive Order (EO) 12088, "Federal Compliance with Pollution Standards," under the authority of the U.S. Environmental Protection Agency (EPA), ensures that necessary actions are taken for the prevention, management, and abatement of environmental pollution from hazardous materials or hazardous waste due to federal activities. Finally, DOD 6050 series publications provide direction for compliance with applicable hazardous materials and waste laws and regulations.

The use and generation of project-related hazardous materials and waste could affect installation management programs. Therefore, relevant aspects of the management of these substances include the applicable regulations and procedures for hazardous materials usage and hazardous waste generation at Edwards and Nellis AFBs. The F-22 would carry live munitions and release chaff and flares over the NRC; therefore, ordnance management is relevant to both Edwards AFB and the NRC.

Other aspects of hazardous materials and hazardous waste management and the reasons they are not relevant to the Proposed Action are discussed in the following paragraph. Although the aircraft designated under F-22 IOT&E would increase aircraft fuel consumption at both bases, these increases are considered too small to affect the overall base fuels management procedures or storage capabilities. The Proposed Action would also utilize existing fuels storage and distribution facilities. Therefore, storage tanks and petroleum, oil, and lubricant management are not considered relevant to this EA. In addition, because the F-22 IOT&E activities do not entail any building construction/modification or ground-disturbing activities, hazardous waste-contaminated sites, asbestos-containing material, lead-based paint, and other aspects of hazardous material and hazardous waste management are not relevant to the project. The Proposed Action would utilize existing base services for pest control and medical services. Therefore, pesticide usage and medical/biohazardous waste will not be further discussed.

The ROI for hazardous materials and hazardous waste management consists of Edwards and Nellis AFBs. As required by EO 12088, both bases must comply with applicable federal, state, and local laws and regulations regarding hazardous materials and hazardous waste. Base management plans, as well as DOD directives, that serve to implement these laws and regulations include hazardous material and waste management plans, spill prevention and contingency plans, and pollution prevention plans that are regularly updated to capture any changes in the mission. Installation management programs for hazardous materials and waste management at Edwards and Nellis AFBs are discussed in the following sections.

3.3.1 Hazardous Materials Management

3.3.1.1 Edwards Air Force Base.

AFFTC 23-1, Hazardous Materials Management Program, sets guidance for all Edwards AFB personnel, tenants, and contractors to manage all hazardous materials to comply with all applicable federal, state, and local requirements, and AFIs.

Edwards AFB uses a hazardous material pharmacy (HAZMART) system. All hazardous materials for operations at the AFFTC are channeled through the Hazardous Materials Cell, and are then dispersed to satellite cells referred to as Hazardous Materials Distribution Support Centers (HDSCs). HAZMART monitors shelf life and tracks usage from cradle to grave of all on-base hazardous materials. Hazardous materials requirements for new on-base programs are incorporated into the HAZMART system through an HDSC Operating Instruction prepared for the new program. When a new test and evaluation program is initiated at Edwards AFB, program initial documents are reviewed by Bioenvironmental Engineering to identify any hazardous material and hazardous waste concerns. Bioenvironmental Engineering maintains a master hazardous materials inventory list for Edwards AFB with all listed Material Safety Data Sheets (U.S. Air Force, 1997c).

Edwards AFB has a Pollution Prevention Plan to fulfill the requirements of EO 12856, Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements, and AFI 32-7080, Pollution Prevention Program. The purpose of the pollution prevention program is to reduce the amount of hazardous substances entering waste streams and to reduce hazards to public health and the environment from the release of hazardous substances. The Edwards AFB Environmental Management Board is responsible for overall management and direction of the pollution prevention program (Edwards Air Force Base, 1996). All organizations are required to reduce the hazardous materials used or replace them with nonhazardous materials if possible (U.S. Air Force, 1997c).

The AFFTC SPR Plan 32-4002 AFFTC Oil and Hazardous Substance Spill Prevention and Response Plan (U.S. Air Force, 1997a) fulfills the requirements of a spill control and countermeasures plan in accordance with 40 CFR Part 112, and an oil and hazardous substance pollution contingency plan in accordance with

40 CFR Part 300. Additionally, Edwards AFB is required to provide annual updates to its business plan in order to comply with community right-to-know requirements.

The variety of hazardous materials used on the flightline at Edwards AFB is larger than at a typical Air Force installation because of the research activities conducted by the AFFTC and its capability to support the Air Force's aircraft inventory. Hazardous materials are mainly used for test and evaluation activity, aircraft and AGE repair and maintenance, and building and site construction and rehabilitation. The most commonly used hazardous materials on the flightline include jet and motor fuels, other types of petroleum products, paints, thinners, adhesives, cleaners, lead-acid batteries, hydraulic fluids, and halogenated and nonhalogenated solvents (U.S. Air Force, 1997c).

3.3.1.2 Nellis Air Force Base.

Management programs for hazardous waste at Nellis AFB are similar to those described for Edwards AFB. Hazardous materials usage relevant to the F-22 IOT&E program includes those associated with flightline activities. Types of materials used would be similar to those used on the Edwards AFB flightline. Nellis AFB uses a HAZMART to manage hazardous materials on the base and range. Most hazardous materials are ordered through base supply, but all purchasers of hazardous materials are instructed to clear items with HAZMART. The HAZMART approval process includes a review and approval process by Bioenvironmental Engineering personnel. The base also has a Pollution Prevention Plan, Nellis AFB Plan 19-1, in accordance with AFI 32-7080, and a Facilities Response Plan, which includes a spill plan.

3.3.2 Hazardous Waste Management

3.3.2.1 Edwards Air Force Base.

Normal operations at Edwards AFB produce waste defined as hazardous by RCRA; U.S. EPA implementing regulations found at 40 CFR Part 261; and California Code of Regulations (CCR) Title 22, Division 4, Chapter 30. Implementation of hazardous waste regulations under the California Hazardous Waste Control Law is the responsibility of the California EPA, Department of Toxic Substances Control. Requirements of the Hazardous Waste Control Law are found in Section 25100, et seq., of the California Health and Safety Code and state hazardous waste regulations under CCR Title 22. Used oil is also regulated as a hazardous waste under California's Management of Used Oil Act.

The Edwards AFB Hazardous Waste Management Plan, Number 32-7042 (Edwards Air Force Base, 1995), provides guidance and procedures for proper management of RCRA and non-RCRA hazardous waste generated on the base. It provides guidance to ensure compliance with applicable federal, state, and local hazardous waste regulations. Edwards AFB has an RCRA Part A permit for a 1-year hazardous waste storage facility (Edwards Air Force Base, 1995).

The AFFTC SPR Plan 32-4002, AFFTC Oil and Hazardous Substance Spill Prevention and Response Plan (U.S. Air Force, 1997a), discussed in Section 3.3.1.1, also applies to hazardous waste because it specifies procedures to be followed when responding to releases, accidents, and spills involving oils or hazardous substances.

Routine activities conducted on the flightline generate hazardous waste. Types of waste generated include lead, mercury, and chromium content paints; partially filled or wet hazardous waste containers; and contaminated rags (U.S. Air Force, 1997c).

3.3.2.2 Nellis Air Force Base.

Management programs for hazardous waste at Nellis AFB are similar to those described for Edwards AFB. Types of hazardous waste generated from flightline activities would be similar to those generated on the Edwards AFB flightline. Hazardous waste generated on Nellis AFB is handled according to Nellis AFB Plan 12, Hazardous Waste Management Plan. The base has an RCRA Part B permit and three 90-day and one 1-year hazardous waste storage facilities.

3.3.3 Ordnance

3.3.3.1 Edwards Air Force Base.

Relevant aspects of ordnance management include the handling of live munitions and chaff and flares at Edwards AFB. Chaff and flares are the principal defense mechanism dispensed from military aircraft to avoid detection and/or attack by adversary air defense systems. Chaff consists of small fibers that reflect radar signals and, when dispensed in sufficient quantities from aircraft, forms a “cloud” that breaks the radar signal and temporarily hides the aircraft from radar detection. Flares provide high-temperature heat sources ejected from aircraft that mislead heat-sensitive or heat-seeking targeting systems. Chaff and flares are used to keep aircraft from being targeted by weapons and other aircraft. Edwards AFB follows the explosives safety procedures contained in Air Force Manual 91-201, Explosives Safety Standards. Munitions are stored and handled on the flightline in specified areas subject to strict management. Each location where live ordnance is stored or handled has a clear zone. Most munitions used on base are inert, but some live ordnance is used for testing and training activities. Explosive ordnance disposal and munitions personnel are responsible for transporting explosives from storage areas to other areas on the flightline (U.S. Air Force, 1997c).

3.3.3.2 Nellis Range Complex.

Relevant aspects of ordnance management include the release of chaff and flares on the range.

Chaff and flare deployment throughout the NRC airspace is governed by a series of regulations based on safety and environmental considerations and limitations. Among these regulations are the following:

- AFI 11-206 prohibits Air Force pilots from allowing any object to be dropped from an aircraft, except in an emergency, without prior approval. Approval is given only when the dropped object will not create a hazard to people, property, or other air traffic.

- AFI 13-212 outlines procedures governing weapons range use of chaff and flares.

- AFI 13-201 establishes practices to decrease disturbances from flight operations and protect the public from the hazards and effects associated with flight operations.

- AFI 11-214 delineates procedures for chaff and flare employment.

All flares are authorized in the numbered and electronic combat ranges on the NAFR. Use of flares in the MOAs comprising the rest of the NRC is limited to one specific type of flare (MJU-7B lots marked "MBT"). Flares may not be dispensed over manned sites, ground parties, or within 3 nm of forested areas. The minimum altitude for flare employment in MOAs is 5,000 feet AGL. Minimum altitude for flare employment in the numbered and electronic combat ranges is 500 feet AGL. Additional restrictions may be imposed depending on weather conditions. The primary concern with flares is their potential to cause fires. Fires have been caused by flares within the NRC, even in areas where minimum release altitudes are 5,000 feet AGL (U.S. Air Force Air Combat Command, 1997).

Chaff may be employed in all of the ranges and MOAs within the NRC between 300 feet AGL and 25,000 feet MSL, except beneath Restricted Area 4806 and populated areas.

In 1995, 394,744 bundles of chaff were dispensed from aircraft over the NRC, and 90,886 flares were used (U.S. Air Force, 1998).

3.4 NATURAL ENVIRONMENT

Aspects of the natural environment discussed in this EA include air quality, noise, biological resources, and cultural resources.

3.4.1 Air Quality

This section provides a description of air quality in general followed by a description of the air quality resources at Edwards AFB and the NRC.

Description of Resource

Air quality in a given location is defined by the concentration of various pollutants in the atmosphere, generally expressed in units of parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). The significance of a pollutant concentration is determined by comparing it to federal and/or state ambient air quality standards. These standards represent the maximum allowable atmospheric concentrations that may occur and still protect public health and welfare with a reasonable margin of safety. The federal standards are established by the U.S. EPA and termed the National Ambient Air Quality Standards (NAAQS). The NAAQS are defined as the maximum acceptable ground-level concentrations that may not be exceeded more than once per year, except for annual standards, which may never be exceeded. These standards include concentrations for ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter equal to or less than 10 microns in diameter (PM_{10}), and lead. The California Air Resources Board (CARB) has established state standards termed the California Ambient Air Quality Standards (CAAQS). The CAAQS are at least as restrictive as the NAAQS and include pollutants for which there are no national standards. The Nevada Division of Environmental Protection (NDEP), Bureau of Air Quality, has adopted the NAAQS to regulate air pollutant levels within the state, with the following exception: the state annual SO_2 standard is more stringent than the national standard. The Bureau of Air Quality within the Utah Department of Health has adopted the NAAQS to regulate pollutant levels in Utah. The national and state ambient air quality standards are shown in Table 3-3.

The pollutants considered in the impact analysis of this EA include volatile organic compounds (VOCs), ozone, CO, nitrogen oxides (NO_x), NO_2, SO_2, and PM_{10}. Airborne emissions of lead are not considered in this EA, since there are no known significant sources of lead associated with the Proposed Action. NO_x and VOCs are of particular concern since they are precursor emissions that form ozone.

Ozone concentrations are generally the highest during the summer and coincide with the period of maximum insulation. Maximum ozone concentrations tend to be regionally distributed, since precursor emissions become homogeneously dispersed in the atmosphere. Inert pollutant concentrations, such as CO, tend to be the greatest during the cooler months of the year and are often a product of light wind conditions and nighttime/early morning surface-based inversions. Maximum inert pollutant concentrations are usually found near an emission source.

Identifying the ROI for air quality requires knowledge of: (1) the types of pollutants being emitted; (2) emission rates of the pollutant source; (3) the proximity of project emission sources to other emission sources; and (4) local and regional meteorological conditions. The ROI for emissions of inert pollutants (pollutants other than ozone and its precursors) is generally limited to a few miles downwind from the source. The ROI for ozone generally extends much farther downwind than the ROI for inert pollutants. In the presence of solar radiation, the maximum effect of precursor emissions on ozone levels usually occurs several hours after their emission and, therefore, many miles from the source.

The U.S. EPA designates all areas of the United States as having air quality better than (attainment) or worse than (nonattainment) the NAAQS. The criteria for nonattainment designation varies by pollutant: (1) an area is in nonattainment for ozone if its NAAQS has been exceeded more than 3 discontinuous times in 3 years; and (2) an area is in nonattainment for any other pollutant if its NAAQS has been exceeded more than once per year. Pollutants in an area are often designated as unclassified when there are insufficient ambient air quality data for the U.S. EPA to form a basis for attainment status. The CARB considers an area to be in nonattainment of a CAAQS if a standard has been exceeded more than once in 3 years.

Table 3-3. National, California, and Nevada Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards	Nevada Standards	National Standards[a]	
				Primary[b,c]	Secondary[b,d]
Ozone	1-hour	0.09 ppm (180 µg/m^3)	0.12 ppm (235 µg/m^3)	0.12 ppm (235 µg/m^3)	Same as primary
	8-hour	---	---	0.008 ppm (157 µg/m^3)	---
Carbon monoxide	8-hour[e]	9 ppm (10 mg/m^3)	9 ppm (10 mg/m^3)	9 ppm (10 mg/m^3)	---
	1-hour	20 ppm (23 mg/m^3)	35 ppm (40 mg/m^3)	35 ppm (40 mg/m^3)	---
Nitrogen dioxide	Annual	---	0.053 ppm (100 µg/m^3)	0.053 ppm (100 µg/m^3)	Same as primary
	1-hour	0.25 ppm (470 µg/m^3)	---	---	---
Sulfur dioxide	Annual	---	0.02 ppm (60 µg/m^3)	0.03 ppm (80 µg/m^3)	---
	24-hour	0.04 ppm (105 µg/m^3)	0.14 ppm (365 µg/m^3)	0.14 ppm (365 µg/m^3)	---
	3-hour	---	---	---	0.5 ppm (1,300 µg/m^3)
	1-hour	0.25 ppm (655 µg/m^3)	---	---	---
PM_{10}	Annual (arithmetic mean)	---	50 µg/m^3	50 µg/m^3	Same as primary
	Annual (geometric mean)	30 µg/m^3	---	---	---
	24-hour	50 µg/m^3	150 µg/m^3	150 µg/m^3	Same as primary
$PM_{2.5}$[e]	Annual arithmetic	---	---	15 µg/m^3	Same as primary
	24-hour	---	---	65 µg/m^3	Same as primary
Lead	Calendar quarter	---	1.5 µg/m^3	1.5 µg/m^3	Same as primary
	30-day average	1.5 µg/m^3	---	---	---

Notes:
(a) Other than for ozone and those based upon annual averages, standards are not to be exceeded more than once per year. The ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standard is equal to or less than one.
(b) Concentrations are expressed first in units in which they were promulgated. Equivalent units given in parentheses.
(c) Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health. Each state must attain the primary standards no later than 3 years after that state's implementation plan is approved by the EPA.
(d) Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after the EPA approves the implementation plan.
(e) The 8-hour ozone standard and the $PM_{2.5}$ standards are included for information purposes only. A 1999 federal court ruling blocked implementation of these standards, which EPA proposed in 1997. EPA has asked the U.S. Supreme Court to reconsider that decision.

EPA = Environmental Protection Agency
µg/m^3 = micrograms per cubic meter
mg/m^3 = milligrams per cubic meter
$PM_{2.5}$ = particulate matter equal to or less than 2.5 microns in diameter
PM_{10} = particulate matter equal to or less than 10 microns in diameter
ppm = parts per million

Air quality regulations were first promulgated with the federal Clean Air Act (CAA). This Act established the NAAQS and delegated the enforcement of air pollution regulations to the states.

In areas where the NAAQS are exceeded, the CAA required preparation of an State Implementation Plan (SIP), detailing how a state would attain the standards within mandated time frames. The CAA revised the attainment planning process. The requirements and compliance dates for reaching attainment are based upon the severity of the air quality standard violation.

The CAA states that a federal agency cannot support an activity unless the agency determines that the activity will conform to the most recent EPA-approved SIP within the region of the proposed action. This means that federally supported or funded activities will not (1) cause or contribute to any new air quality standard violation; (2) increase the frequency or severity of any existing standard violation; or (3) delay the timely attainment of any standard or any required interim emission reductions or other milestones in any area.

Ongoing activities are exempt from the rule as long as there is no increase in emissions above the de minimis levels specified in the rule. Table 3-4 presents the de minimis threshold level of nonattainment areas.

Table 3-4. De Minimis Threshold in Nonattainment Areas

Pollutant	Degree of nonattainment	De Minimis Level (tons/year)
Ozone (VOCs and NO_x)	Serious	50
	Severe	25
	Extreme	10
	Marginal and Moderate (outside an ozone transport region)	100
	Marginal and Moderate (outside an ozone transport region)	50 100
CO	All	100
Particulate Matter	Moderate	100
	Serious	70
SO_2 or NO_2	All	100
Lead	All	25

CO = carbon monoxide
NO_2 = nitrogen dioxide
NO_x = nitrogen oxides
SO_2 = sulfur dioxide
VOC = volatile organic compound

In addition to meeting de minimis requirements, a federal action must not be considered a regionally significant action. A federal action is considered

regionally significant when the total emissions from the action equal or exceed 10 percent of the air quality control area's emissions inventory for any criteria pollutant.

If a federal action meets de minimis requirements and is not considered a regionally significant action, it is exempt from further conformity analyses pursuant to 40 CFR Part 93.153. If modifications to the proposed action occur in the future, or if attainment counties are reclassified based on the new NAAQS or monitoring data, a revision to the conformity analysis may be required for those areas.

The impact on visibility from air pollutant emissions sources is an issue with regard to federally mandated Class I areas, such as national parks and wilderness areas, where any appreciable deterioration in air quality is considered significant.

Areas in attainment with the NAAQS are regulated under the Prevention of Significant Deterioration (PSD) program authorized by the CAA Part C, Sections 160-169. PSD areas require that owners and/or operators of new or modified sources obtain a PSD permit prior to construction of a major source (40 CFR Part 5221) situated in attainment or unclassified areas. A major source is defined by PSD regulations as being a specific type of source listed by the U.S. EPA that has a potential of emitting 100 tons per year of a regulated pollutant. Potential to emit is based on the maximum design capacity of a source and takes into account pollution control efficiency. If a source is not listed by the U.S. EPA, it may still be considered major if it has the potential to emit 250 tons per year of a regulated pollutant.

3.4.1.1 Edwards Air Force Base.

The following sections provide a description of the ROI, climate, baseline air quality and emissions, and regulatory setting for the Edwards AFB and R-2508 Complex area.

Region of Influence. The project region in California would mainly be in the Mojave Desert Air Basin (MDAB) of eastern California. However, airspaces used by project aircraft would also include portions of Fresno, Tulare, and Kern counties in the San Joaquin Valley Air Basin; Inyo County in the Great Basin Valleys Air Basin; Los Angeles County in the South Coast Air Basin; and Ventura County in the South Central Coast Air Basin. Figure 1-1 shows the project airspaces and associated counties within the California project region.

Climate. Hot summers, cool winters, low rainfall, large diurnal ranges in temperature, and abundant sunshine characterize the climate of this ROI. The aridity of the region is mainly due to the rainshadow effects of the Sierra Nevada and San Gabriel mountains, where the prevailing westerly winds deposit most of their moisture on the western slopes of these mountain ranges. Data collected at Edwards AFB from 1979 to 1989 are used to describe the climate of the project region (National Oceanic and Atmospheric Administration, 1997c).

The dominant weather feature in the project region is the Eastern Pacific high pressure system. This system is most dominant during the summer, when it occupies a northern position over the Pacific Ocean. Concurrent with the presence of the high pressure, a low-level, thermal low-pressure system persists over the desert regions due to intense surface heating. The relative strengths and positions of the high-pressure system and the interior thermal trough are largely responsible for the general climatic conditions of the region.

Precipitation. During the winter, the Eastern Pacific high-pressure system weakens and moves southward, allowing polar storm systems to migrate through the region. Although the systems that reach the region have dried out considerably after traversing the elevated terrain to the west, they are responsible for most of the annual precipitation in the area. The average annual precipitation at Edwards AFB is 4.9 inches. Rainfall during the summer usually occurs from thunderstorms. Moisture from these storms originates from tropical air masses that move into the region from the south-southeast. Snow can occur in the region, although the average total is only about 2 inches per year.

Temperature. The annual average temperature at Edwards AFB is 62 degrees (°) Fahrenheit (F). Daily mean high and low temperatures for January are 57°F and 31°F, respectively. Daily mean high and low temperatures for July are 98°F and 66°F, respectively. Extreme temperatures that occurred during the 10-year monitoring period ranged from 4°F to 113°F.

Prevailing Winds. The combination of the Eastern Pacific high-pressure system over the Pacific Ocean and the thermal low over the interior desert produces a prevailing southwest wind in the region. Strong winds occur during the spring and summer, when the pressure gradient between the offshore Pacific High and the interior thermal trough is the greatest. However, extreme wind gusts can also occur with thunderstorms. Calm conditions increase during the fall and winter, when cold continental air replaces the thermal low and produces weak pressure gradients.

Baseline Air Quality and Emissions. Table 3-5 presents a summary of the attainment status of the project area in California. These data show that the majority of the region is in nonattainment of the state and national standards for ozone and PM_{10} and in attainment or unclassified for CO_2, NO_2, and SO_2 ambient air quality standards. With regard to the NAAQS, Edwards AFB is designated as a “serious” ozone nonattainment area and is in attainment or unclassified for all other pollutants.

Pollutants transported from the Los Angeles metropolitan area and the San Joaquin Valley into the MDAB are responsible for many of the high ozone levels recorded in the region. Elevated levels of PM_{10} are primarily associated with fugitive dust, which is produced through a combination of (1) high winds, (2) dry soil conditions resulting from an arid climate, and (3) ground-disturbing activities such as mining, agriculture, and construction.

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Table 3-5. National/California Ambient Air Quality Standards Attainment Designations[a] for California F-22 Project Region

County/Air Basin	Ozone	CO	NO_2	SO_2	PM_{10}
Kern/MDAB[b]	N/N	U*/U	U*/A	U/A	U,N/N
San Bernardino/MDAB[c]	A,N/N	U*/A	U*/A	U/A	N/N
Inyo/GBVAB[d]	U*/U	U*/A	U*/A	U/A	U,N/N
Kern/SJVAB	N/N	U*/A	U*/A	A/A	N/N
Los Angeles/MDAB	N/N	U*/A	U*/A	U/A	U/N
Los Angeles/SCAB	N/N	N/N	N/A	A/A	N/N
Ventura/SCCAB[c]	N/N	U*/A	U*/A	A/A	U/N
Tulare/SJVAB	N/N	U*/A	U*/A	U/A	N/N
Fresno/SJVAB	N/N	U*/A	U*/A	U/A	N/N

Notes:
(a) Designation status: A = attainment, N = nonattainment, U = unclassified, and U* = unclassified/attainment.
(b) With regard to the NAAQS for PM_{10}, the entire county within the MDAB is unclassified/attainment for the federal standard, except the Searles Valley Planning Area, which is in nonattainment.
(c) With regard to the NAAQS for ozone, the western portion of San Bernardino County within the MDAB is in nonattainment, and the eastern portion is in attainment.
(d) With regard to the NAAQS for PM_{10}, the entire county within the MDAB is unclassified/attainment, except the Searles Valley and Owens Valley planning areas, which are in nonattainment.

CO = carbon monoxide
GBVAB = Great Basin Valley Air Basin
MDAB = Mojave Desert Air Basin
NO_2 = nitrogen dioxide
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SCAB = South Coast Air Basin
SCCAB = South Central Coast Air Basin
SJVAB = San Joaquin Valley Air Basin
SO_2 = sulfur dioxide

Source: California Environmental Protection Agency, Air Resources Board, 1997.

Table 3-6 provides a summary of aircraft emissions at Edwards AFB in 1997. The current emissions baseline for the upper atmosphere within the airspace at Edwards AFB is approximately 54,000 sorties annually.

Table 3-6. Summary of Existing Aircraft Emissions at Edwards AFB (tons/year)[a]

VOC	CO	NO_x	SO_2	PM_{10}
219.5	488.3	350.9	32.9	26.5

Note: (a) Represents emissions that occurred in 1996 (U.S. Air Force, 1997b).
CO = carbon monoxide
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound

Edwards AFB is situated in the MDAB portion of Kern County. Current and forecasted baseline emissions for this portion of Kern County are listed in Table 3.7.

Table 3-7. Kern County (Mojave Desert Air Basin Portion) Emission Baseline and Forecasted Emission Baseline (tons/year)

Year	VOC	NO_x	PM_{10}
1990[a]	6,022.5	NA	25,548
1996[b]	4,945.7	14,231.3	17,328[c]
1999[b]	4,978.6	14,811.70	NA

Notes: (a) Actual.
(b) Estimated.
(c) PM_{10} estimated for 1994.
NA = not available
NO_x = Nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
VOC = volatile organic compound

Sources: Kern County Air Pollution Control District 1993a; 1994a; 1996.

Regulatory Setting. In California, the CARB is responsible for enforcing air pollution regulations. The CARB has, in turn, delegated the responsibility of regulating stationary emission sources to local air agencies. The only stationary sources of emissions associated with the Proposed Action (i.e., engine runs in the Test Cell and Hush House) would occur in the portion of Edwards AFB within Kern County. This area is within the desert eastern portion of Kern County, which is part of the MDAB. Therefore, the analysis will include only the portion of Kern County within the MDAB. Inflight aircraft emissions are generally unregulated within the project region.

The Kern County Air Pollution Control District (KCAPCD) has prepared three planning documents to demonstrate attainment of the NAAQS for ozone in the MDAB portion of Kern County: (1) a 1993 Rate-of-Progress Plan (Kern County Air Pollution Control District, 1993b), (2) a Reasonable Further Progress Plan (Kern County Air Pollution Control District, 1994a), and (3) an Attainment Demonstration Plan (Kern County Air Pollution Control District, 1994b). These documents outline baseline and future regional emission inventories, mandated emission reductions, and a demonstration by computer modeling that the federal ozone standard will be attained by 1999. However, measures to control aircraft emissions are not required in the attainment planning process. The KCAPCD ozone attainment planning process allows for plentiful growth in ozone precursor emissions at Edwards AFB through 1999. These three attainment plans have been approved by the U.S. EPA and are included in the California ozone SIP. Local air agencies within the remainder of the project region have also produced plans to attain the NAAQS. Project emissions within these areas would occur mainly from inflight aircraft. Control measures to limit aircraft emissions are not included in attainment plans.

General conformity requirements have been incorporated into various state rules and regulations. Ventura County Air Pollution Control District, San Joaquin Valley Unified Air Pollution Control District, and South Coast Air Quality Air District have amended and included general conformity requirements as part of the SIP.

The R-2508 Complex includes Class I areas at Death Valley National Park, Sequoia National Park, Kings Canyon National Park, and the Domeland National Wilderness Area (see Figure 3-1).

3.4.1.2 Nellis Range Complex.

The following sections provide a description of the ROI, climate, baseline air quality and emissions, and regulatory setting for the NRC.

Region of Influence. The project region would include portions of Clark, Lincoln, and Nye counties in Nevada; and Iron and Washington counties in Utah. Figure 1-2 shows the project airspaces and associated counties within the NRC project region.

Climate. The climate of the NRC region is similar to the climate discussed for the Edwards AFB region in Section 3.4.1.1, with the following exceptions: (1) due to a more continental setting, winter temperatures are slightly cooler and snowfall is slightly more frequent; and (2) summer rainfall and thunderstorm frequencies are slightly higher.

Baseline Air Quality and Emissions. The project area within Nevada is unclassified for the state and national standards, except for Clark County, which is designated as a "serious" CO and PM_{10} nonattainment area with regard to the NAAQS (Nevada Division of Environmental Protection, 1997). Nonattainment of CO occurs within the Las Vegas metropolitan area due to vehicular emissions on congested roadways. Elevated levels of PM_{10} are primarily associated with fugitive dust. Iron County in Utah is in attainment or unclassified for all NAAQS. Table 3-8 provides a summary of aircraft emissions in the NRC in 1995. The current emission baseline conditions for the upper atmosphere within the NRC airspace reflect approximately 200,000 to 300,000 sortie operations.

Table 3-8. Estimated Aircraft Emissions in NRC (tons/year)

	VOC	CO	NO_x	SO_2	PM_{10}
200,000 sortie operations/year	15.0	110.5	2,083.1	81.8	35
300,000 sortie operations/year	24.3	165.6	3,124.4	122.5	528

CO = carbon monoxide
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound

Source: U.S. Air Force, 1999.

Regulatory Setting. The NDEP Bureau of Air Quality regulates sources of air pollution within the Nevada project region. Within Clark County, stationary sources of emissions are regulated by the Clark County Health District, Air Pollution Control Division (CCAPCD).

Death Valley National Park is approximately 25 miles west of the NRC and is the nearest Class I area to the project area. Zion National Park in Utah and Great Basin National Park in Nevada are within 50 miles of the NRC.

The CCAPCD has prepared two planning documents to demonstrate attainment of the NAAQS for CO and PM_{10} in Clark County: CO Air Quality Implementation Plan for the Las Vegas Valley Nonattainment Area, Clark County, Nevada (Clark County Board of Commissioners, 1995), and Draft PM (PM_{10}) Air Quality Implementation Plan for the Las Vegas Valley Nonattainment Area, Clark County, Nevada (Clark County Board of Commissioners, 1997). The U.S. EPA has yet to take action on the CO Air Quality Implementation Plan. The PM_{10} plan is currently in progress. When completed, it will be submitted to the U.S. EPA for approval. However, measures to control aircraft emissions are not required in the regional attainment planning process.

3.4.2 Noise

Noise is generally defined as sound that is undesirable because it: (1) is intense enough to damage hearing; (2) interferes with speech communication and sleep; or (3) is annoying. Sound can vary simultaneously in level (or loudness) and frequency content (pitch), while also varying in time of occurrence and duration. The fundamental measure of sound level is expressed in units called decibels (dB) using a logarithmic scale. Common sounds vary in amplitude over a range of many millions. For instance, an aircraft fly-over may produce a pressure amplitude a hundred times greater than a car driving by on a nearby street. On the logarithmic scale, these noise sources would differ by 40 dB. Table 3-9 provides a comparison of common sound levels. Because humans are more sensitive to certain frequencies of sounds than to others, a frequency weighting system designated as A-weighting is often used to express magnitude of sounds in terms relevant to people's hearing. A-weighted sound levels are expressed as decibels A-weighted (dBA).

The primary sources of noise in jet-powered aircraft such as the F-22 arise from the engines during subsonic flight and from shock waves generated by the passage of the aircraft body through the air at supersonic speeds. Engine noise is divisible into that portion arising from the roar of the jet exhaust stream and the higher-pitched noise generated from the internal rotating machinery in the engine itself. The use of afterburners increases the exhaust stream velocity, thereby increasing the noise level. A secondary source of noise in jet-powered aircraft is that generated by the movement of the aircraft through the air. At subsonic speeds greater than approximately 450 knots, this noise can dominate that produced by the engines. A more detailed discussion of sound is presented in Appendix C.

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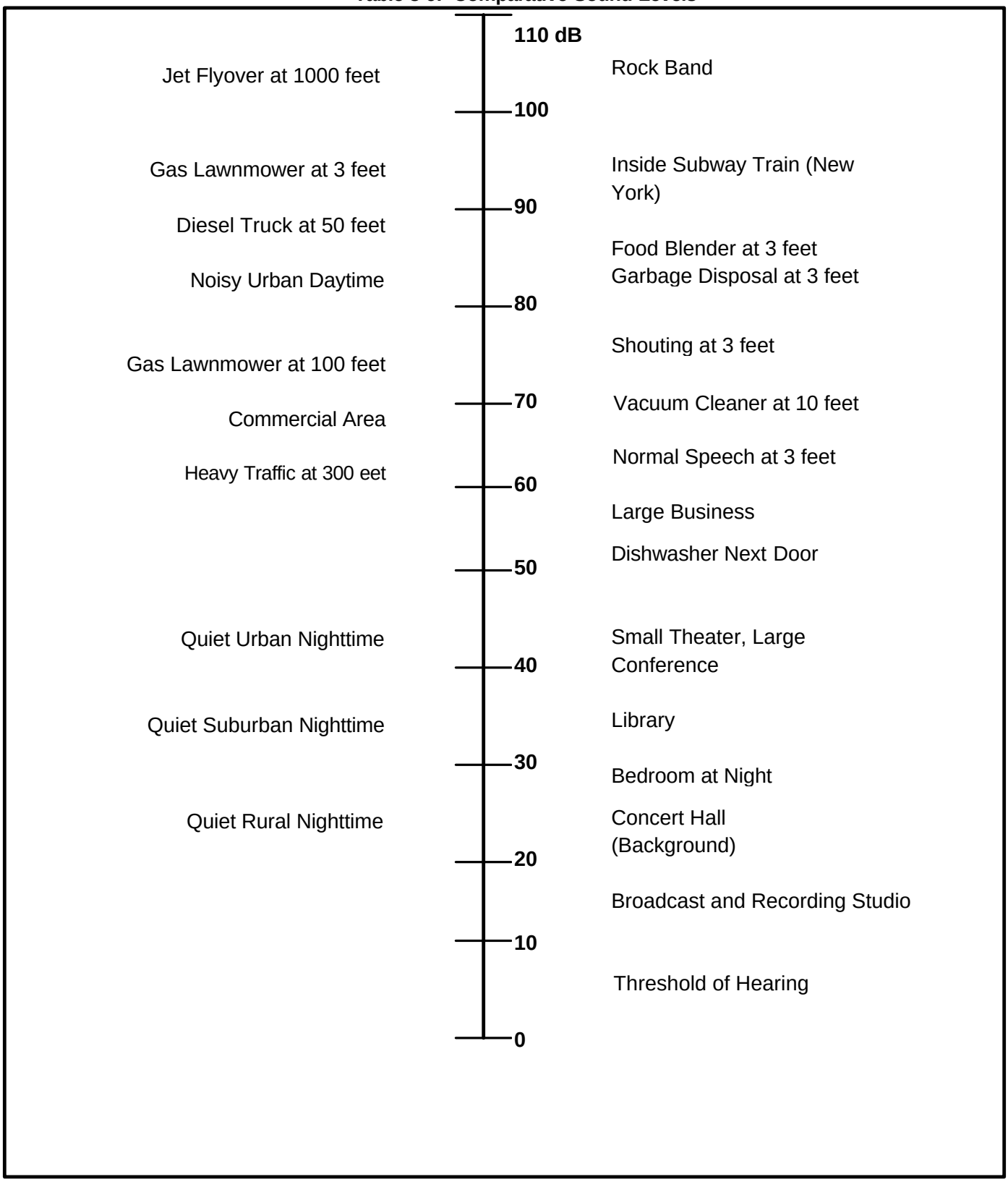
Table 3-9. Comparative Sound Levels



It is the policy of federal agencies such as the FAA, DOD, Department of Housing and Urban Development (HUD), and the U.S. EPA to assess long-term, cumulative exposure to environmental noises including aircraft traffic, and rail noise in terms of day-night average sound level (DNL). In the State of California, another noise metric, the community noise equivalent level (CNEL) is used. CNEL noise levels are calculated similarly to DNL noise levels except that a 3-dB "penalty" is added to noise that occurs between 7:00 p.m. and 10:00 p.m. Unless the majority of noise-generating activities occur within this 3-hour period, the difference between noise levels measured in DNL and CNEL is usually within 1 dB. For purposes of this EA, noise levels presented in CNEL are considered comparable to DNL levels. The Federal Interagency Committee on Urban Noise has developed land use compatibility guidelines for noise (U.S. Department of Transportation, 1980). Table 3-10 provides these recommended DNL ranges for various land use categories based upon this committee's findings. DNL values of 65 dB and less are normally compatible with residential land uses.

The ROI for noise is defined using land use compatibility guidelines for noise-sensitive receptors such as residential units, hospitals, classrooms, recreation areas, and golf courses that may be affected by noise from aircraft activities. These would normally include areas within the DNL 65-dB contour. For F-22 IOT&E, this includes those areas potentially affected by F-22 aircraft ground operations at Edwards AFB and those areas that may be exposed to F-22 aircraft overflight noise and sonic booms generated by F-22 IOT&E flight operations within the R-2508 Complex, the HASC, and the NRC.

Sonic Booms. When an object travels faster than the speed of sound in the surrounding air, the air in front of the object is compressed abruptly, forming a shock wave. This shock wave is a sudden increase in pressure, followed by a gradual decrease to below ambient pressure, then a sudden return to ambient atmospheric pressure. Aircraft within the Earth's atmosphere typically produce two shock waves as they travel at supersonic speeds, one at the nose and one at the tail. These waves produced by the vehicle can propagate to the ground where they are perceived as a "boom." When describing the magnitude of a sonic boom, it is conventional to use only the incremental increase in pressure (in terms of pounds per square foot [psf]) over ambient atmospheric pressure, approximately 2,116 psf at sea level. This quantity is termed "overpressure." Factors that affect the nature and extent of sonic boom overpressures include aircraft design and operation, and atmospheric effects. Pressure waves are generated any time an object exceeds the speed of sound, and thus are generated for all supersonic flights. However, these pressure waves do not always propagate to the ground where they are perceived as a sonic boom. A more detailed discussion of sonic booms is presented in Appendix C.

Although humans do not hear very low frequencies very well, they do feel vibration from these low frequencies, and they can hear sounds produced by vibration induced within buildings. DOD has followed the recommendations of the National Research Council - Committee on Hearing, Bioacoustics and Biomechanics Assembly in describing high-intensity impulsive sounds, such as sonic booms and

explosions, in terms of C-weighted sound exposure level. Impacts on the community noise environment due to a series of these events is

Table 3-10. Land Use Compatibility
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Land Use	Noise Zones			
	65-69 dB	70-74 dB	75-79 dB	80 + dB
Residential				
Household units				
Single units; detached	A[1]	B[1]	N	N
Single units; semidetached	A[1]	B[1]	N	N
Single units; attached row	A[1]	B[1]	N	N
Two units; side-by-side	A[1]	B[1]	N	N
Two units; one above the other	A[1]	B[1]	N	N
Apartments; walk up	A[1]	B[1]	N	N
Apartments; elevator	A[1]	B[1]	N	N
Group quarters	A[1]	B[1]	N	N
Residential hotels	A[1]	B[1]	N	N
Mobile home parks or courts	N	N	N	N
Transient lodgings	A[1]	B[1]	C[1]	N
Other residential	A[1]	B[1]	N	N
Manufacturing				
Food and kindred products; manufacturing	Y	Y[2]	Y[3]	Y[4]
Textile mill products; manufacturing	Y	Y[2]	Y[3]	Y[4]
Apparel and other finished products made from fabrics, leather, and similar materials; manufacturing	Y	Y[2]	Y[3]	Y[4]
Lumber and wood products (except furniture); manufacturing	Y	Y[2]	Y[3]	Y[4]
Furniture and fixtures; manufacturing	Y	Y[2]	Y[3]	Y[4]
Paper and allied products; manufacturing	Y	Y[2]	Y[3]	Y[4]
Printing, publishing, and allied industries	Y	Y[2]	Y[3]	Y[4]
Chemicals and allied products; manufacturing	Y	Y[2]	Y[3]	Y[4]
Petroleum refining and related industries	Y	Y[2]	Y[3]	Y[4]
Rubber and miscellaneous plastic products; manufacturing	Y	Y[2]	Y[3]	Y[4]
Stone, clay, and glass products; manufacturing				
Primary metal industries	Y	Y[2]	Y[3]	Y[4]
Fabricated metal products; manufacturing	Y	Y[2]	Y[3]	Y[4]
Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks; manufacturing	Y	A	B	N
Miscellaneous manufacturing	Y	Y[2]	Y[3]	Y[4]

Table 3-10. Land Use Compatibility
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Land Use	Noise Zones			
	65-69 dB	70-74 dB	75-79 dB	80+ dB
Transportation, communications, and utilities				
Railroad, rapid rail transit, and street railroad transportation	Y	Y[2]	Y[3]	Y[4]
Motor vehicle transportation	Y	Y[2]	Y[3]	Y[4]
Aircraft transportation	Y	Y[2]	Y[3]	Y[4]
Marine craft transportation	Y	Y[2]	Y[3]	Y[4]
Highway and street right-of-way	Y	Y[2]	Y[3]	Y[4]
Automobile parking	Y	Y[2]	Y[3]	Y[4]
Communications	Y	A[5]	B[5]	N
Utilities	Y	Y	Y[2]	Y[3]
Other transportation communications and utilities	Y	A[5]	B[B]	N
Trade				
Wholesale trade	Y	Y[2]	Y[3]	Y[4]
Retail trade – building materials, hardware, and farm equipment	Y	Y[2]	Y[3]	Y[4]
Retail trade – general merchandise	Y	A	B	N
Retail trade – food	Y	A	B	N
Retail trade – automotive, marine craft, aircraft, and accessories	Y	A	B	N
Retail trade – apparel and accessories	Y	A	B	N
Retail trade – furniture, home furnishings, and equipment	Y	A	B	N
Retail trade – eating and drinking establishments	Y	A	B	N
Other retail trade	Y	A	B	N
Services				
Finance, insurance, and real estate services	Y	A	B	N
Personal services	Y	A	B	N
Cemeteries	Y	Y[2]	Y[3]	Y[4,10]
Business services	Y	A	B	N
Repair services	Y	Y[2]	Y[3]	Y[4]
Professional services	Y	A	B	N
Hospitals, nursing homes	A*	B*	N	N
Other medical facilities	Y	A	B	N
Contract construction services	Y	A	B	N
Government services	Y*	A*	B*	N
Educational services	A*	B*	N	N
Miscellaneous services	Y	A	B	N

Table 3-10. Land Use Compatibility
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Land Use	Noise Zones 65-69 dB	70-74 dB	75-79 dB	80+ dB
Cultural, entertainment and recreational				
Cultural activities (including churches)	A*	B*	N	N
Nature exhibits	Y*	N	N	N
Public assembly	Y	N	N	N
Auditoriums, concert halls	A	B	N	N
Outdoor music shell, amphitheaters	N	N	N	N
Outdoor sports arenas, spectator sports	Y^{6}	Y^{6}	N	N
Amusements	Y	Y	N	N
Recreational activities (including golf courses, riding stables, water recreation)	Y*	A*	B*	N
Resorts and group camps	Y*	Y*	N	N
Parks	Y*	Y*	N	N
Other cultural, entertainment, and recreation	Y*	Y*	N	N
Resources production and extraction				
Agriculture (except livestock)	Y^{7}	Y^{8}	Y^{9}	$Y^{9,10}$
Livestock farming and animal breeding	Y^{7}	Y^{8}	Y^{9}	$Y^{9,10}$
Agricultural related activities	Y^{7}	Y^{8}	N	N
Forestry activities and related services	Y^{7}	Y^{8}	Y^{9}	$Y^{9,10}$
Fishing activities and related services	Y	Y	Y	Y
Mining activities and related services	Y	Y	Y	Y
Other resources production and extraction	Y	Y	Y	Y

Y	=	(Yes) – Land use and related structures are compatible without restriction.
N	=	(No) – Land use and related structures are not compatible and should be prohibited.
Y^{X}	=	(Yes, with restrictions) - Land use and related structures are generally compatible; see notes indicated by the superscript.
N^{X}	=	(No, with exceptions) - See notes indicated by the superscript.
NLR	=	(Noise Level Reduction) - NLR (outdoor to indoor) to be achieved through incorporation of noise attenuation measures into the design and construction of the structures.
A, B, or C	=	Land use and related structures generally compatible; measures to achieve NLR for A(DNL/CNEL 65-69), B(DNL/CNEL 70-74), C(DNL/CNEL 75-79), need to be incorporated into the design and construction of structures.
A*, B*, and C	=	Land use generally compatible with NLR. However, measures to achieve an overall noise level reduction do not necessarily solve noise difficulties, and additional evaluation is warranted. See appropriate footnotes.
*	=	The designation of these uses as "compatible" in this zone reflects individual federal agencies and program considerations of general cost and feasibility factors, as well as past community experiences and program objectives. Localities, when evaluating the application of these guidelines to specific situations, may have different concerns or goals to consider.

Notes:

1.(a) Although local conditions may require residential use, it is discouraged in DNL/CNEL 65-69 dB and strongly discouraged in DNL/CNEL 70-74 dB. The absence of viable alternative development options should be determined, and an evaluation indicating that a demonstrated community need for residential use would not be met if development were prohibited in these zones, should be conducted prior to approvals.

(b) Where the community determines the residential uses must be allowed, measures to achieve outdoor-to-indoor Noise Level Reduction (NLR) for DNL/CNEL 65-69 dB and DNL/CNEL 70-74 dB should be incorporated into building codes

and considered in individual approvals.

Table 3-10. Land Use Compatibility
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Notes (continued):

(c) NLR criteria will not eliminate outdoor noise problems. However, building location and site planning, and design and use of berms and barriers can help mitigate outdoor exposure, particularly from near ground-level sources. Measures that reduce outdoor noise should be used whenever practical in preference to measures that protect only interior spaces.

2. Measures to achieve the same NLR as required for facilities in DNL/CNEL 65-69-dB range must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.
3. Measures to achieve the same NLR as required for facilities in DNL/CNEL 70-74 dB range must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.
4. Measures to achieve the same NLR as required for facilities in DNL/CNEL 75-79 dB range must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise-sensitive areas, or where the normal noise level is low.
5. If noise sensitive, use indicated NLR; if not, the use is compatible.
6. Land use is compatible provided special sound reinforcement systems are installed.
7. Residential buildings require the same NLR as required for facilities in DNL/CNEL 65-69 dB range.
8. Residential buildings require the same NLR as required for facilities in DNL/CNEL 70-74 dB range.
9. Residential buildings are not permitted.
10. Land use is not recommended. If the community decides the use is necessary, hearing protection devices should be worn by personnel.

DNL = day/night average sound level
CNEL = Community Noise Equivalent Level

Source: U.S. Air Force, 1992a.

quantified with the C-weighted day-night level (CDNL). In contrast with A-weighting, which suppresses low frequencies similarly to the response of human hearing, C-weighting allows more of the low-frequency energy in a sound signal to be measured. Table 3-11 summarizes the relationship developed between the CDNL of sonic booms and annoyance. Daily exposure to sonic booms of CDNL 61 dB or less is comparable to the DNL 65-dB significance level for non-impulse noise and is normally considered compatible with most land uses.

Table 3-11. Percentage of Population Highly Annoyed by Sonic Boom Exposure

CDNL Interval dB	Percentage Highly Annoyed
<61	<15
61-65	15-25
65-69	25-37
69-73	37-52

CDNL = C-weighted day-night level
dB = decibel

Source: National Academy of Science, 1977.

Many studies have been conducted of the effects of sonic booms on conventional (i.e., modern, inhabited) structures. The most common incidence of damage is to glass, plaster, and bric-a-brac, as summarized in Table 3-12. The actual

occurrence of damage depends upon a number of variables; most important are the orientation of the object to the flight track and the condition of the object.

Table 3-12. Possible Damage to Structures from Sonic Booms

Sonic Boom Peak Overpressure Nominal (psf)	Type of Damage	Item Affected
0.5-2	Cracks in plaster	Fine; extension of existing; more in ceilings; over door frames; between some plaster boards.
	Cracks in glass	Rarely shattered; either partial or extension of existing.
	Damage to roof	Slippage of existing loose tiles/slates; sometimes new cracking of old slates at nail hole.
	Damage to outside walls	Existing cracks in stucco extended.
	Bric-a-brac	Those carefully balanced or on edges can fall; fine glass (e.g., large goblets).
	Other	Dust fall in chimneys.
2-4	Glass, plaster, roofs, ceilings	Failures show that would have been difficult to forecast in terms of their existing localized condition. Nominally in good condition.
4-10	Glass	Regular failures within a population of well installed glass; industrial as well as domestic; green houses; ships; oil rigs.
	Plaster	Partial ceiling collapse of good plaster; complete collapse of very new, incompletely cured, or very old plaster.
	Roofs	High probability rate of failure in nominally good slate, slurry-wash; some chance of failures in tiles on modern roofs; light roofs (bungalow), or large area can move bodily.
	Walls (outside)	Old, free-standing walls in fairly good condition can collapse.
	Walls (inside)	"Party" walls known to move at 10 psf.
Greater than 10	Glass	Some good glass will fail regularly in response to sonic booms from the same direction. Glass with existing faults could shatter and fly. Large window frames move.
	Plaster	Most plaster affected.
	Ceilings	Plaster boards displaced by nail popping.
	Roofs	Most slate/slurry roofs affected, some badly; large roofs having good tile can be affected; some roofs bodily displaced causing gable-end and wall-plate cracks; Domestic chimneys - dislodgment if not in good condition.
	Walls	Internal party walls can move even if carrying fittings such as hand basins or taps; secondary damage due to water leakage.
	Bric-a-brac	Some nominally secure items can fall (e.g., large pictures; especially if fixed to party walls).

psf = pounds per square foot

Source: U.S. Air Force, HSD-TR-89-01.

Studies indicate that only 1 pane in 1 million of new glass properly installed would be broken by 1 psf of overpressure, and only 23 in 1 million if each pane were installed perpendicular to the approach flight path of the aircraft (Hershey and Higgins, 1979).

3.4.2.1 Edwards Air Force Base.

The ROI for Edwards AFB includes the base, the R-2508 Complex airspace, and the HASC. This includes areas within Los Angeles, San Bernardino, Kern,

Fresno, Tulare, Inyo, and Ventura counties in California, and Clark County in Nevada (see Figure 1-1). The local ROI for existing military aircraft noise sources at Edwards AFB includes the surrounding communities of Lancaster, Palmdale, Mojave, California City, Rosamond, Boron, and Randsburg/Johannesburg (see Figure 3-1). The primary noise sources at Edwards AFB are subsonic and supersonic aircraft operations. Secondary sources include surface traffic, rail service operations, engine run-up and other tests, and equipment required for ground facilities operations.

Existing Noise Levels. Current aircraft operations out of Edwards AFB are both subsonic and supersonic. Noise due to subsonic flights is produced from engine/propulsion noise and airflow noise generated as the airframe passes through the air. The same noise sources are present with supersonic flights, but the aircraft are often at such an altitude that this noise has been greatly reduced because of distance and atmospheric absorption.

Figure 3-8 presents the CNEL 65-dB and greater contours for operations at Edwards AFB. From August 1992 to July 1993, there were 118,867 air operations at Edwards AFB (U.S. Air Force, 1997c). An "operation" occurs each time an aircraft passes over the end of a runway. A touch-and-go maneuver or a flyby would be counted as two operations because, in each case, the aircraft passes over both ends of the runway. The CNEL 65-dB contour is contained within the base boundary. A discussion of aircraft operations and the types of aircraft used in the R-2508 Complex is provided in Section 3.2.1.

The Air Installation Compatible Use Zone (AICUZ) program was established by the DOD to prevent incompatible development adjacent to military facilities. According to Air Force guidelines, an installation's AICUZ study should be updated when noise levels increase by more than DNL 2 dB. Because the DNL 65-dB contour does not extend off base, Edwards AFB does not have an AICUZ study.

From 1980 to 1994, the number of supersonic operations in the HASC averaged between 11 and 44 per month. For the same time period, the number of supersonic operations in the Black Mountain Supersonic Corridor averaged between 7 and 21 per month. During a 10-month period beginning in June 1993, the sonic boom complaints from the supersonic flights in the HASC ranged from 0 to 13 per month, corresponding to an average of approximately 13 supersonic operations per month (U.S. Air Force, 1995b). Maximum overpressures would occur directly under flight paths in the Black Mountain Supersonic Corridor. The maximum overpressure experienced was when the largest supersonic airplane, approximating the size of the B-1, flew over at 1,000 feet AGL at Mach 1.5. This overpressure is estimated to be 82.8 psf, or 0.575 pound per square inch. These flights occur infrequently, compared to flights of the other types of aircraft using the corridor, and the corridors are situated over isolated and uninhabited desert terrain. Overpressures for the majority of sonic booms run a nominal 1.3 psf (U.S. Air Force, 1995b).

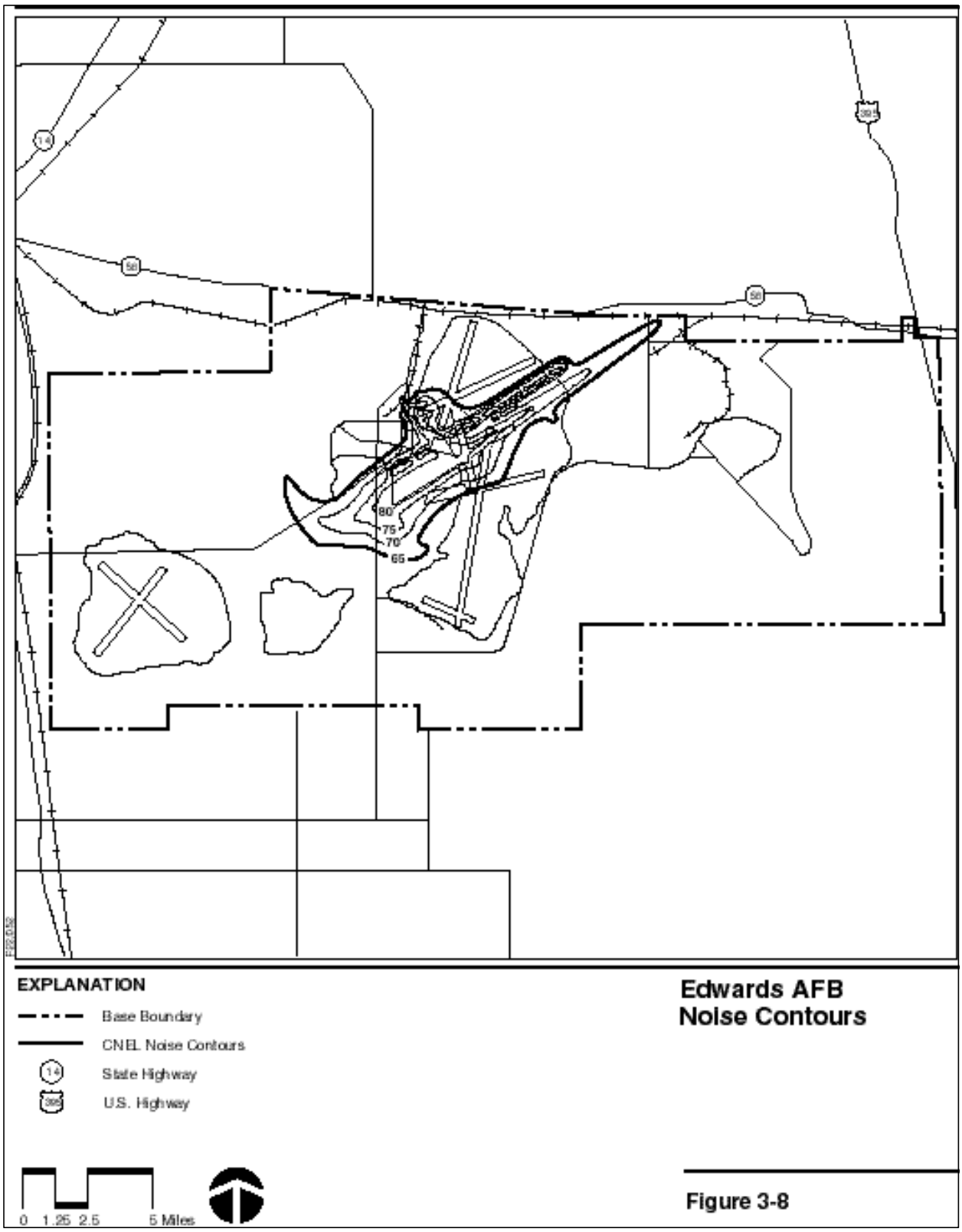

14
58
395
80
75
70
65
EXPLANATION
Base Boundary
CNEL Noise Contours
State Highway
U.S. Highway
0 1.25 2.5 5 Miles
Edwards AFB
Noise Contours

Figure 3-8

Engine Run-up. During the normal preflight checkout and maintenance of jet engines, the engines are often operated for a few minutes or more, usually at idle speed, but occasionally at maximum engine speed. This run-up activity typically occurs near the area where the aircraft are normally parked or near the maintenance areas. For aircraft having multiple engines, this can involve one to all of the aircraft's engines. Table 3-13 presents a summary of recent annual jet and turbo fan engine run-up activities at Edwards AFB. If an aircraft has multiple engines operating, the actual run-up duration has been multiplied by the number of engines operating.

Table 3-13. Summary of Annual Engine Run-up Activity at Edwards AFB, 1996

	Duration, engine minutes			
Aircraft	Total Annual	Minimum/ Occurrence	Maximum/ Occurrence	Occurrence days/year
F-15	6,062	3	1,510	95
F-16	4,104	1	261	77
T-38	3,832	1	370	55
B-1B, B-52, C-135, C-141, C-17, C-18	3,878	1	360	33
Total	17,876			

Noise levels produced by these aircraft during run-up activities range from less than 85 dBA to over 125 dBA at 50 feet. Noise from aircraft engines is typically higher behind the aircraft than in front or to the side. Noise levels will typically drop over 6 dBA for each doubling of distance from the engine.

Ground crews are required to wear hearing protection in accordance with Air Force Occupational Safety and Health (AFOSH) Standard 48-19, Standardized Occupational Health Programs.

3.4.2.2 Nellis Range Complex.

The ROI for noise includes the entire NRC. Numerous Air Force and other service aircraft operate on a regular basis within the NRC, participating in various combat-readiness training exercises. These exercises include both subsonic and supersonic activity. Table 3-14 summarizes a worst-case scenario between May 1990 and June 1991, and March 1992 to September 1992 (U.S. Air Force, 1994a). Of the 3,385 sorties, approximately 96 percent were flown during acoustic daylight hours (7 a.m. to 10 p.m.). F-16s and F-15s are utilized to conduct approximately 70 percent of the sorties in the NRC. The DNL in all airspace is within normally acceptable land use compatibility guidelines, as shown in Table 3-10.

The noise environment at the NRC ranges up to DNL 65 dB within a 25-square-mile area of uninhabited desert plains and mountains. The DNL in all other areas in the range are less than 65 dBA (U.S. Air Force, 1994a).

Table 3-14. Nellis Air Force Range Group Schedule Sorties, April 1992

	Operating Arena							
	Red Flag Mission Debriefing System Tracking Data		Air Combat Maneuver Instrumentation Tracking Data		Others		Total	
Aircraft	Day	Night	Day	Night	Day	Night	Day	Night
F-111	56	0	0	0	0	0	56	0
F-18	275	8	153	0	2	0	430	8
F-16	325	28	524	12	417	22	1,266	62
F-15	449	32	322	4	146	6	917	42
F-14	55	8	0	0	14	0	69	8
F-5	12	2	0	0	0	0	12	2
F-4	84	0	2	0	3	0	89	0
A-10	40	0	4	0	223	0	267	0
A-6	38	8	20	0	8	0	66	8
B-2	0	9	0	0	0	9	0	18
Other	50	3	12	0	0	0	62	3
Total	1,384	98	1,037	16	813	37	3,234	151

Source: U.S. Air Force, 1994a.

The number of sonic booms per month that is heard on the ground at any location within the portions of the NRC authorized for supersonic operations ranges from 2 booms per month for an area that's not often used for supersonic operations like the R74 sub-division to 43 booms per month for an area that's frequently used for supersonic operations like the Elgin sub-division. The booms per month value, is based on the total number of sonic booms generated and the average area affected by each. It represents the number that would be heard, on average, by an individual on the ground under the airspace. Individual sonic boom footprints would affect areas from about 10 square miles to 100 square miles, which is a small portion (0.12-1.19 percent) of the area under the airspace authorized for supersonic operations (U.S. Air Force, 1999). The average overpressure generated by the sonic booms was 0.93 psf. The cumulative distribution of booms (i.e., the percentage of booms exceeding various overpressures) is summarized in Table 3-15.

The sonic boom exposure of the Elgin subdivision of the NRC has a CDNL of 55 to 60 dB. Sonic boom exposure for the remainder of the NRC is below 50 dB (U.S. Air Force, 1994a).

3.4.3 Biological Resources

Biological resources include the native and introduced plants and animals that may occur within the project area. For discussion purposes, biological resources are divided into vegetation, wildlife, threatened and endangered species, and sensitive habitats. Threatened or endangered species include those plants and animals

afforded protection under the federal ESA of 1973, as amended, and other legislation. Sensitive habitat includes wetlands, plant communities that are

Table 3-15. Cumulative Probability of Exceeding Peak Overpressures

Peak Overpressure (psf)	Probability of exceeding (%)
0.2	90
0.25	80
0.33	70
0.44	60
0.58	50
0.75	40
0.95	30
1.4	20
2.1	10
3.1	5
7.5	1
17	.1

psf = pounds per square foot

Source: U.S. Air Force, 1994a.

unusual or are of limited distribution, and important seasonal use areas for wildlife (e.g., migration routes, breeding and nesting areas, environments that are vital to the existence of a species).

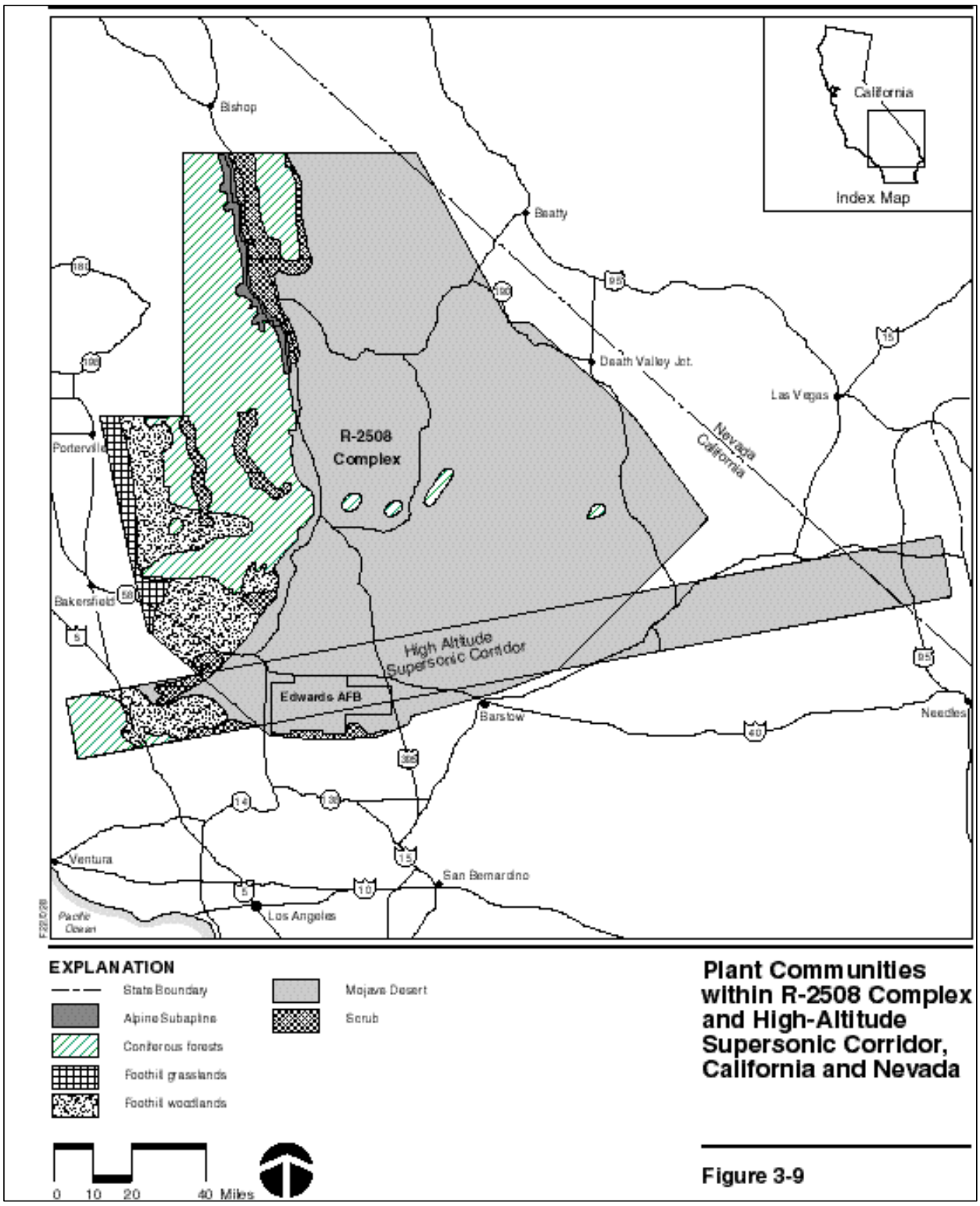
The ROI for biological resources is the area potentially affected by the project activities, including ground operations and flight activities. Ground operations would occur at Edwards AFB; flight activities would be conducted in designated airspace at both subsonic and supersonic speeds at various elevations. The biological resources ROI for Edwards AFB includes the base and the areas beneath the R-2508 Complex and the HASC in California and Nevada. The ROI for the NRC includes the areas beneath the NRC in Nevada and Utah. Both Edwards AFB and Nellis AFB, have an active "bird aircraft strike hazard" (BASH) program to assist pilots in preventing bird strikes on aircraft. The program provides established guidance and advisory procedures for bird avoidance, both around the base and on low-altitude flying routes that are integrated into the BASH program.

3.4.3.1 Edwards Air Force Base

Vegetation. Plant communities within the ROI are illustrated in Figure 3-9 and are identified in the following sections. Descriptions of these plant communities are provided in Appendix E.

Plant communities within most of the ROI contain species that are adapted to the xeric environments of the Mojave Desert. Mojave Desert plant communities include creosote bush scrub, Joshua tree woodland, arid-phase saltbush scrub, halophytic-phase saltbush scrub, lake beds, and mesquite woodlands.

The western portion of the R-2508 Complex overlies the Sierra Nevada Range and a portion of the San Joaquin Valley. The western portion of the HASC overlies a portion of the Tehachapi and San Gabriel mountains. The vegetation



Plant Communities within R-2508 Complex and High-Altitude Supersonic Corridor, California and Nevada

Figure 3-9

contained in these regions differs substantially from the xeric vegetation found within the Mojave Desert. Mountain slope elevation and the accompanying microclimate gradient results in a zonation of plant communities on east- and west-facing slopes. The elevation distribution of plant communities largely accounts for the habitat variety found within the ROI.

Several coniferous forest types occur in the Sierra Nevada Range, including red fir forest, yellow pine forest, mixed coniferous forest, and pinyon-juniper woodlands. Subalpine forests dominated by high-elevation pines, and alpine habitats, also known as fell fields, occur at high elevations in the Sierra Nevada Range.

Foothill grasslands, also known as valley grasslands, are dominated by various grass species. This low-growing herbaceous community is limited to the lower elevations of the western Sierra Nevada Range and the San Joaquin Valley. Foothill woodlands are dominated by oaks at lower elevations and certain pines at upper elevations on the western side of the Sierra Nevadas. Various nondesert scrub communities are also common in the ROI. Scrub communities found within the ROI include shadscale scrub, chaparral, and sage-grass (also known as sagebrush grassland).

Wildlife. Wildlife species occurring within the ROI include those adapted to a variety of habitats. Several federally and state-protected species that may be found within the ROI are discussed in the Threatened and Endangered Species section.

Mojave Desert. Widespread wildlife within the Mojave Desert includes native species including kangaroo rats (*Dipodomys* spp.), western pipistrelle (*Pipistrellus hesperus*), little brown bat (*Myotis lucifugus*), desert woodrat (*Neotoma lepida*), deer mouse (*Peromyscus maniculatus*), coyote (*Canis latrans*), and bobcat (*Felis rufus*). Common birds include turkey vulture (*Cathartes aura*), common raven (*Corvus corax*), sage sparrow (*Amphispiza belli*), and western meadowlark (*Sturnella neglecta*). Reptiles common to all desert habitats include desert spiny lizard (*Sceloporus magister*), side-blotched lizard (*Uta stansburiana*), western whiptail (*Cnemidophorus tigris*), and zebra-tailed lizard (*Callisaurus draconoides*).

Birds are very mobile species and tend to occupy favored habitats within their range. Common bird species found within the Mojave Desert include red-tailed hawk *(Buteo jamaicensis*), killdeer (*Charadrius vociferus*), and white-crowned sparrow (*Zonotrichia leucophrys*). Large birds and bird flocks are known to present hazards to aircraft, typically below 5,000 feet in elevation, depending upon local terrain.

Coniferous Forests and Alpine/Subalpine. Amphibians typically found in coniferous forests include salamanders (*Batrachoseps* spp.), western toad (*Bufo boreas*), and mountain yellow-legged frog (*Rana muscosa*). Reptiles include Sierra alligator lizard (*Gerrhonotus coerulus*), rubber boa (*Charina bottae*), and western rattlesnake (*Crotalus viridis*).

Bird species found throughout montane habitats in California include mountain chickadee (*Parus gambeli*), yellow-rumped warbler (*Dendroica coronata*), Clark's nutcracker (*Nucifraga columbiana*), and Williamson's sapsucker (*Sphyrapicus thyroideus*). Seasonal migrants include mountain bluebird (*Sialia currocoides*), dark-eyed junco (*Junco hyemalis*), and white-crowned sparrow (*Zonotrichia leucophrys*).

Mammals commonly found in montane habitats include black bear *(Ursus americanus*), mountain lion (*Felis concolor*), and yellow-bellied marmot *(Marmota flaviventris*).

Foothill Grasslands. Amphibians typically found in foothill grasslands include western toad and Pacific tree frog (*Pseudacris regilla*). Reptiles include California whiptail (*Cnemidophorus tigris mundus*) and western rattlesnake (*Crotalus viridis*).

Bird species found throughout San Joaquin grasslands include western meadowlark, horned lark (*Eremophila alpestris*), yellow-billed magpie (*Pica nuttalli*), and white-tailed kite (*Elanus leucurus*). Seasonal migrants include western bluebird (*Sialia mexicana*) and white-crowned sparrow.

Mammals commonly found in grassland habitats include coyote, long-tailed weasel (*Mustella frenata*), and California ground squirrel (*Spermophilus beecheyi*).

Foothill Woodlands. Amphibians and reptiles typically found in foothill woodlands include many of the same species found in other woodlands and grasslands. Bird species found in foothill woodland habitats include acorn woodpecker (*Melanerpes formicivorus*), northern flicker (*Colaptes auratus*), great-horned owl (*Bubo virginianus*), and bushtits (*Psaltriparus minimus*). Seasonal migrants include Hutton's vireo (*Vireo huttoni*), Bullock's oriole (*Icterus bullockii*), and lark sparrow (*Chondestes grammacus*).

Mammals commonly found in foothill woodlands include mule deer (*Odocoileus hemionus*), bobcat, and California myotis bat (*Myotis californicus*).

Scrub. Amphibians and reptiles typically found in scrub include toads (*Bufo* spp.), side-blotched lizard, and western fence lizard (*Sceloporus occidentalis*). Bird species found in scrub include scrub jay (*Aphelecoma coerulescens*), wrentit (*Chamea fasciata*), Bewick's wren (*Thryomanes bewickii*), and California thrasher (*Toxostoma reduvivum*). Mammals commonly found in scrub include

brush rabbit (*Sylvilagus bachmani*), gray fox (*Urocyon cineroargentinus*), and light-footed woodrat (*Neotoma fuscipes*).

Threatened and Endangered Species. A number of federally and state-listed threatened and endangered animal species are known to be present in the ROI (Table 3-16). Discussions of protected and sensitive species presented according to the plant communities they inhabit are provided below. Geographic locations described below are shown in Figure 3-10.

Mojave Desert. The desert tortoise (*Gopherus agassizii*) is one of three tortoise species of the genus Gopherus that occur in the United States. Desert tortoises inhabit the Mojave, Colorado, and Sonoran deserts in the southwestern United States and adjacent areas in Mexico. The species is geographically divided by the Colorado River into the Sonoran and Mojave populations. The Mojave population was formally listed as threatened by the USFWS in 1990.

Desert tortoises, known to occur within the ROI, prefer creosote scrub vegetation and firm soils for burrow construction. However, they can be found in other habitat types in relatively lower population densities. The highest densities of the desert tortoise are typically found in creosote scrub and Joshua tree woodlands, but saltbush-series vegetation also supports lower densities.

Fishes protected by endangered species regulations include the state- and federally listed as endangered Mohave tui chub (*Gila bicolor mohavensis*), Owens tui chub (*Gila bicolor snyderi*), and the Owens pupfish (*Cyprinodon radiosus*), and the state-listed as threatened cottonball marsh pupfish (*Cyprinodon salinus milleri*). The Mojave tui chub once inhabited the deep pools and slough-like areas in the Mojave River. Tui chub is the only fish native to that drainage. Populations of this fish have been transplanted to several places throughout the Mojave Desert, including the NAWCPNS (within the R-2508 Complex). The Owens tui chub was formerly found throughout the Owens River basin in weedy shallows of spring-fed ponds and streams. Today they are found in only a few locations including a spring near Owens Dry Lake. Owens pupfish were formerly found in the Owens River system but are now found in only a few springs and ponds. The cottonball marsh pupfish is restricted to the Cottonball Marsh in Death Valley (Steinhart, 1990).

The federally listed as threatened western snowy plover (*Charadrius alexandrinus nivosus*) inhabits shores of ephemeral lakes and perennial waters of the desert, and has been recorded at Rosamond Dry Lake on Edwards AFB and at Harper Dry Lake and Koehn Dry Lake (U.S. Army Corps of Engineers, et al., 1997). The federally listed as threatened and the state-listed as endangered bald eagle (*Haliaeetus leucocephalus*) may winter near larger water bodies in the southern portion of the R-2508 Complex, including Harper Dry Lake. The federally listed as endangered and state-listed as threatened Yuma clapper rail (*Rallus longirostris yumanensis*) is a resident in shallow, freshwater marshes with dense stands of cattails and bulrushes. It has been recorded in the marsh of Harper Dry Lake (U.S. Army Corps of Engineers, et al., 1997). The federally and state-listed as

endangered Least Bell's vireo (*Vireo bellii pusillus*) is restricted to riparian areas containing dense willow thickets; its breeding range in the ROI is restricted to an area along the Amaragosa River. The Inyo California towhee (*Pipilo crisallis eremophila*) inhabits only the Argus Mountains of southern Inyo County. This federally listed as threatened and state-listed as endangered species requires dense willow and scrub habitat.

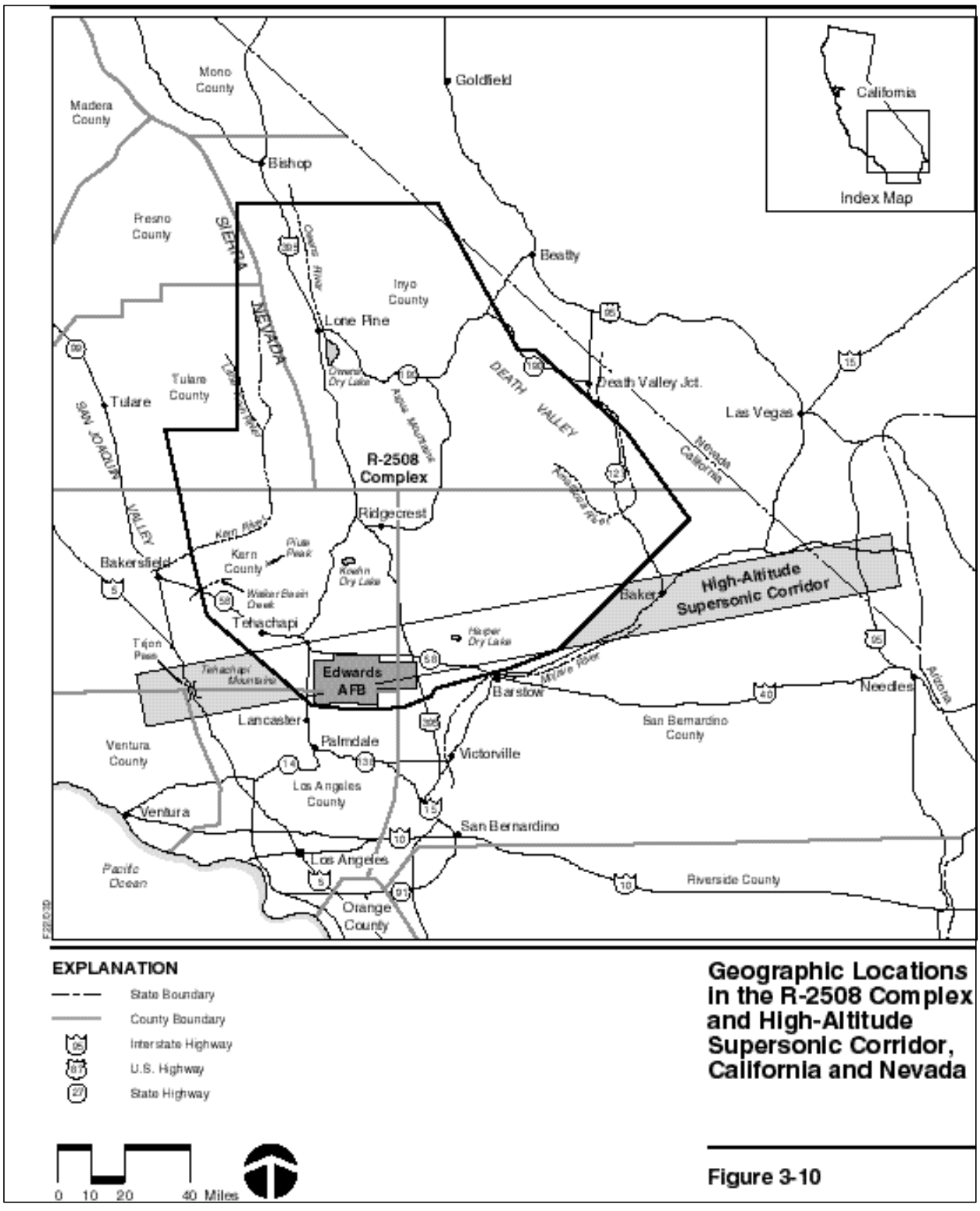
The Amaragosa vole (*Microtus californicus scirpenis*) is a small rodent that inhabits the Amaragosa River drainage; it is federally and state listed as endangered. Several other species of concern may occur in the Mojave Desert

Table 3-16. Federally and State-Listed as Threatened and Endangered Animal Species in Edwards AFB ROI

Scientific Name	Common Name	Federal Status	State Status
Invertebrates			
Euproserpinus euterpe	Kern primrose sphinx moth	T	-
Desmocerus californicus	Elderberry longhorn beetle	T	-
Fish			
Gila bocolor snyderi	Owns tui chub	E	E
Gila bicolor mohavensis	Mojave tui chub	E	E
Cyprinodon radiosus	Owens pupfish	E	E
Cyprinodon salinus milleri	Cottonball Marsh pupfish	-	T
Onchorhynchus aquabonita whitei	Little Kern golden trout	T	-
Onchorhynchus clarki henshawi	Lahontan cutthroat trout	T	-
Reptiles and Amphibians			
Batrachoseps stimatus	Kern Canyon slender	-	T
Batrachoseps stebbensi	Tehachapi slender salamander	-	T
Rana aurora draytoni	California red-legged frog	T	-
Charina bottae umbratica	Southern rubber boa	-	T
Gopherus agassizii	Desert tortoise	T	T
Gambelia silus	Blunt-nosed leopard lizard	E	E
Birds			
Strix nebulosa	Great gray owl	-	E
Empidonax trailii	Willow flycatcher	-	E
Charadrius alexandrinus nivosus	Western snowy plover	T	CSC
Haliaeetus leucocephalus	Bald eagle	T	E
Rallus longirostris yumanensis	Yuma clapper rail	E	T
Vireo bellii pusillus	Least Bell's vireo	E	E
Coccyzus americanus	Western yellow-billed cuckoo	-	E
Falco peregrinus anatum	Peregrine falcon	Delisted	E
Aquila chrysaetos	Golden eagle	Protected	CSC
Pipilo crissalis eremophila	Inyo California towhee	T	E
Branta canadensis leucopaeria	Aleutian Canada goose	T	-
Buteo swainsonii	Swainson's hawk	-	T
Riparia riparia	Bank swallow	-	T
Gymnogyps californianus	California condor	E	E
Mammals			
Microtus californicus scirpenis	Amaragosa vole	E	E
Spermophilus mohavensis	Mohave ground squirrel	-	T
Vulpes vulpes necator	Sierra Nevada red fox	-	T
Vulpes macrotis mutica	San Joaquin kit fox	E	T
Dipodomys ingens	Giant kangaroo rat	E	E
Dipodomys nitratoides nitratoides	Tipton kangaroo rat	E	E
Gulo gulo	California wolverine	-	T
Ovis canadensis californiana	California (=Sierra) bighorn	E	E
Ammospermophilus nelsoni	San Joaquin antelope squirrel	-	T

CSC = California species of special concern
E = endangered
ROI = region of influence
T = threatened

Sources: U.S. Army Corps of Engineers et al., 1997; California Department of Fish and Game, 2001.



Geographic Locations in the R-2508 Complex and High-Altitude Supersonic Corridor, California and Nevada

Figure 3-10

portion of the ROI, including the state-threatened Mohave ground squirrel (*Spermophilus mohavensis).*

Coniferous Forests and Alpine/Subalpine. Two federally listed as threatened fish species occur within the Sierra Nevada portion of the ROI. Little Kern golden trout *(Oncorhynchus aquabonita whitei*) inhabits the Little Kern River tributary of the Kern River. The Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) is a rare trout found on the eastern side of the Sierra Nevada.

One amphibian, the California red-legged frog (*Rana aurora draytonii*), a federally listed as threatened species, occurs in the foothill and montane portions of the Sierra Nevada. A state-listed as threatened reptile, the Southern rubber boa (*Charina bottae umbratrica*), inhabits an area west of Lake Isabella (U.S. Army Corps of Engineers, et al., 1997). The American peregrine falcon *(Falco peregrinus anatum*) is state listed as endangered. This raptor (bird of prey) nests on cliffsides and on other rock outcrop areas. The great gray owl (*Strix nebulosa*) and willow flycatcher (*Empidonax trailii*) are listed as endangered by the state of California and occur in coniferous and willow riparian forests, respectively. Another state-listed as endangered bird, the western yellow-billed cuckoo (*Coccyzus americanus occidentalis*), occurs in riparian forests along the Kern River. It is also found in a small area along the Amaragosa River in the Mojave Desert.

California bighorn sheep (*Ovis canadensis californiana*), federally and state-listed as endangered, are residents of the most remote mountain wilderness areas within the ROI. Several species listed as threatened by the state of California occur within the Sierra Nevada portion of the ROI. The Kern Canyon slender salamander (*Batrachoseps stimatus*) is found only in the canyons of the lower Kern River. Wolverine (*Gulo gulo*) rarely reside in the remote high Sierra Nevada habitats. The Sierra Nevada red fox (*Vulpes vulpes necator*) is a seldom-seen nocturnal predator in this region.

Foothill Grasslands. Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) is a federally listed as threatened insect distributed within elderberry-dominated drainages throughout the San Joaquin Valley. The blunt-nosed leopard lizard (*Gambelia silus*) is both state- and federally listed as endangered, and occurs in sparsely vegetated plains and foothills. The Aleutian Canada goose (*Branta candensis leucopareia*) is a federally listed as threatened species that winters in the San Joaquin Valley. The San Joaquin kit fox (*Vulpes macrotis mutica*) is federally listed as endangered and state listed as threatened, and occurs in grasslands from Tracy south to southern Kern County. The giant kangaroo rat (*Dipodomys ingens*) and Tipton kangaroo rat (*Dipodomys nitratoides nitratoides*) are both state and federally listed as endangered species. The giant kangaroo rat occurs on or just outside the western limits of the R-2508 Complex in Kern County. The Tipton kangaroo rat once ranged throughout much of the southern San Joaquin Valley. Its populations are currently restricted to just several sites in the southern portion of that valley.

State-listed species occurring in the ROI include the threatened San Joaquin antelope squirrel (*Ammospermophilus nelsoni*) found only in the southern San Joaquin Valley. Swainson's hawk (Buteo swainsonii) and bank swallow (*Riparia riparia*) are both listed as state threatened, and although uncommon, nest at sites throughout the San Joaquin Valley.

Foothill Woodlands and Scrub. Kern primrose sphinx moth (*Euproserpinus euterpe*) is federally listed as threatened and is known only from a 5-acre area in the Walker Basin east of Bakersfield. The California condor (*Gymnogyps californianus*) is both federally and state listed as endangered but has been essentially extirpated from the wild. Efforts to reintroduce this species into the wild are currently underway. The Tehachapi slender salamander (*Batrachoseps stebbensi*) is state listed as threatened, with a distributional range that is restricted to an area between Piute Mountain and Tejon Pass.

Sensitive Habitats. Sensitive habitats include federally and state-regulated wetlands, sensitive species habitat, plant communities that have been identified as unusual or of limited distribution, and important seasonal use areas for wildlife (e.g., breeding and nesting areas).

Under federal definition, wetlands are "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (Environmental Laboratory, 1987). The majority of jurisdictional wetlands in the United States meet three wetland delineation criteria (hydrophytic vegetation, hydric soils, and wetland hydrology) and are subject to Section 404 of the Clean Water Act (CWA). Additionally, EO 11990, Protection of Wetlands, specifies that federal agencies shall avoid wetlands and shall not provide assistance for new construction in wetlands unless the agency finds that there are no practicable alternatives to such construction, and that the action include all practicable measures to minimize disturbance to wetlands.

Wetland and riparian areas are not uncommon within the ROI. They are particularly important wildlife areas in arid regions, providing resources such as water and forage. In addition, these areas tend to attract higher concentrations of species than surrounding habitats. Many playas, ephemeral and vernal pools, meadows, marshes, rivers, lakes, and drainages throughout the ROI potentially qualify as Waters of the United States. These areas are protected by Section 404 of the federal CWA and are under the jurisdiction of the U.S. Army Corps of Engineers.

In addition to wetlands and riparian areas, the ROI contains USFWS-designated critical habitat for several protected species. Desert tortoise critical habitat is present within the ROI. Important habitat for desert bighorn sheep and species identified in the Threatened and Endangered Species section also occur within the

ROI. Some pools and drainages are the only habitat for certain fish species, such as pupfish.

Two sensitive ecological areas, as defined by the county of Los Angeles, occur within Edwards AFB: Piute Ponds, in the southwestern corner of the base, supports a significant number of waterfowl and provides a stopover area for migratory birds. Mesquite woodlands, in the south-central portion of Edwards AFB, provide a unique habitat for wildlife such as phainopepla (*Phainopepla nitens)* and loggerhead shrike (*Lanius ludovicianus*).

3.4.3.2 Nellis Range Complex.

Vegetation. Although much of the NRC portion of the ROI supports Great Basin desert vegetation, the NRC also lies within the northeastern range of the Mojave Desert. Because of this, the NRC contains vegetation similar to that of Edwards AFB. The Mojave and Great Basin desert vegetation communities also meet to form a broad transitional band that includes components of both desert ecosystems. Vegetation formations occurring on the NRC are illustrated in Figure 3-11 and include the Mojave Desert plant communities of creosote bush scrub, arid-phase saltbush scrub, halophytic-phase saltbush, Joshua tree woodland, and lake beds. Shadscale scrub, blackbrush scrub (shown as shadscale in Figure 3-11), and sage grass including sagebrush scrub and galleta-bluegrama scrub-steppe are other low-elevation plant communities (Latting, 1995). Pinyon-juniper and montane vegetation occur at higher elevations (see Figure 3-11). Descriptions of these plant communities are provided in Appendix E.

Wildlife. Wildlife species are similar to those present in the Edwards AFB ROI. Bighorn sheep (*Ovis canadensis*), pronghorn (*Antilocarpa americana*), and mule deer (*Odocoileus hemionus*) are large herbivores that may be found on the NAFR. Feral horses (*Equus caballos*) and feral burros (*Equus asinus*) are also present on the northern portion of the NAFR. Mountain lions (*Felis concolor*) prey upon these large animals. Coyote is an opportunistic predator common to all but the most developed areas. Golden eagles (*Aquila chrysaetos*) are known to occur in the ROI, nesting in areas of high relief such as ridges and large rock outcrops. Golden eagle nest sites were observed on the NAFR, which suggests that golden eagles occur there in low densities (Nellis Air Force Base, 1996c). Raptors are protected by the Bald and Golden Eagle Protection Act.

Numerous bat species occur throughout the ROI, generally favoring areas of open water or riparian systems for forage. These animals typically roost in crevasses of rock outcrops, trees, unoccupied buildings, and unoccupied mines during the day, and set out to forage at dusk. Bats found within the ROI feed primarily on insects. A variety of prey, both flying and terrestrial, may be hunted, depending upon the bat species. Bat distributions are influenced by water availability, prey abundance, and temperature (especially at roost sites).

Threatened and Endangered Species. Fifteen federally or state listed as endangered or threatened animal species are potentially present on the NRC (Table 3-17). Big spring spinedace (*Lepidomeda mollispinis pratensis*), Hiko White River Springfish (*Crenichthys baileyi grandis*), Railroad Valley springfish (*Crenichthys nevadae*), White River spinedace (*Lepidomeda albivallis*), and White River springfish (*Crenichthys baileyi baileyi*) are listed fish species for which the USFWS has designated critical habitat. The Big Spring spinedace is found in Pioche Hills of Lincoln County within the Caliente East subdivision of the Desert MOA. The Hiko White River spinedace and the White River springfish are

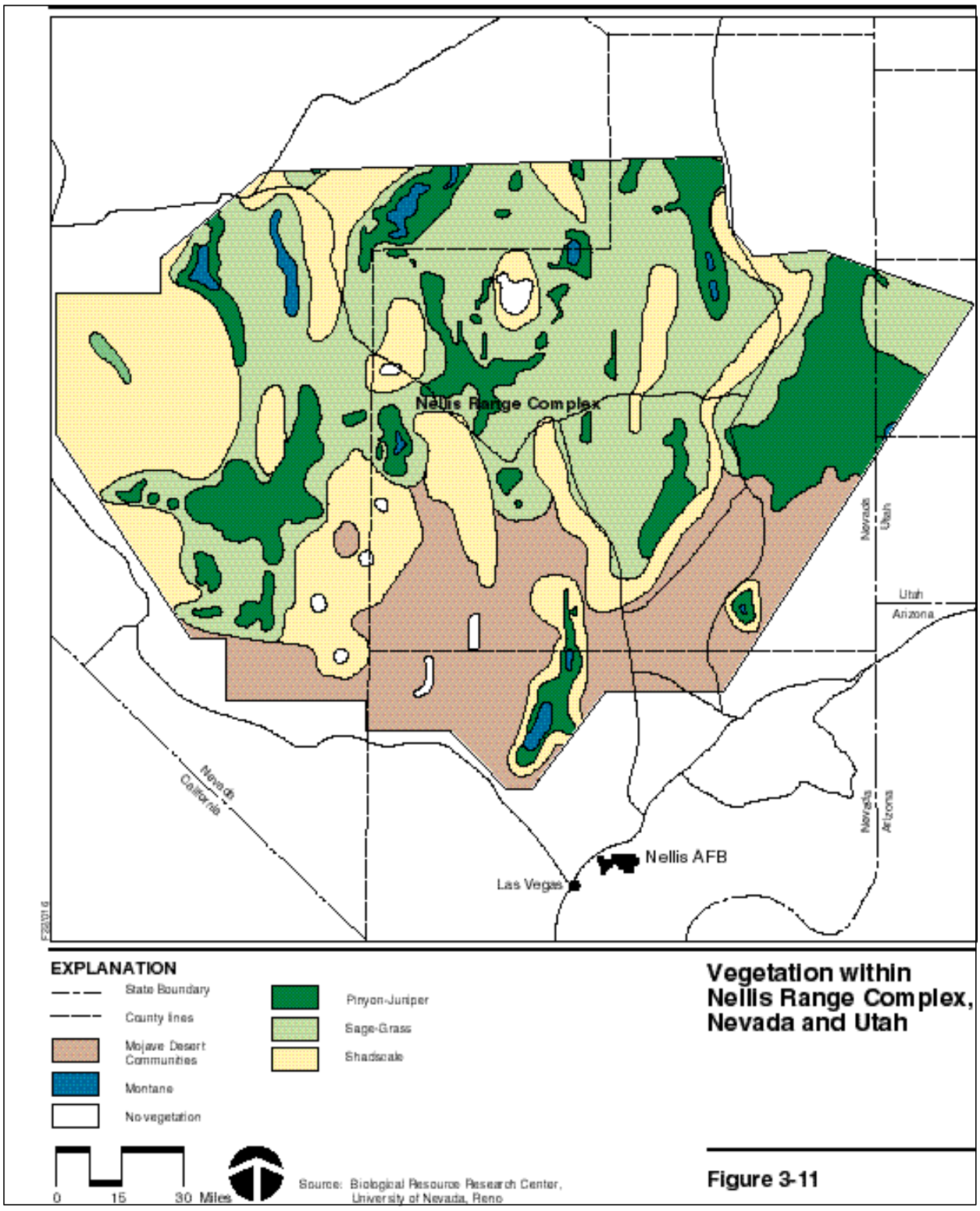

Nellis Range Complex
Nevada
Utah
Utah
Arizona
Nevada
California
Nevada
Arizona
Nellis AFB
Las Vegas
F22V01d
EXPLANATION
State Boundary
County lines
Mojave Desert Communities
Montane
No vegetation
Pinyon-Juniper
Sage-Grass
Shadscale
0
15
30 Miles
Source: Biological Resource Research Center, University of Nevada, Reno
Vegetation within Nellis Range Complex, Nevada and Utah
Figure 3-11

Table 3-17. Federally and State-Listed as Threatened and Endangered Animal Species in Nellis Range Complex

Scientific Name	Common Name	Federal Status	State Status[(a)]
Fish			
Lepidomeda mollispinis pratensis	Big Spring spinedace	T	-
Lepidomeda albivallis	White River spinedace	E	-
Chrenicthys nevadae	Railroad Valley springfish	T	-
Chrenicthys baileyi grandis	White River springfish	E	-
Chrenicthys baileyi baileyi	Hiko White River springfish	E	-
Moapa coriacea	Moapa dace	E	E
Gila robusta jordani	Pahranagat roundtail chub	E	E
Empetrichthys latos	Pahrump poolfish	E	E
Reptiles and Amphibians			
Gopherus agassizii	Desert tortoise	T	T
Birds			
Falco peregrinus anatum	Peregrine falcon	Delisted	-
Haliaeetus leucocephalus	Bald eagle	T	E
Charadrius montanus	Mountain plover	C	-
Strix occidentalis lucida	Mexican spotted owl	T	T (Utah)
Mammals			
Euderma maculatum	Spotted bat	-	T
Cynomys parvidens	Utah prairie dog	T	T (Utah)

Note: (a) Nevada, unless otherwise noted.
C = candidate
E = endangered
T = threatened

Sources: U.S. Air Force, 1994a; 1998.
Utah Division of Wildlife Resources, 1998.
U.S. Fish and Wildlife Service, 2000.

found in the Pahranagat Valley within the Coyote Bravo and Coyote Charlie subdivisions of the Desert MOA. The Railroad Valley springfish is found in the Duckwater and Lockes areas in Nye County. The White River spinedace is found in the Flag Springs area in Nye County. Three additional federally listed fish species may also be found on the NRC. These are the Moapa dace (*Moapa coriacea*), found in the Moapa NWR, the Pahranagat roundtail chub (*Gila robusta jordani),* found in the Pahranagat Valley, and the Pahrump poolfish (*Empetrichthys nevadae*), found in Clark County (U.S. Air Force, 1994a; 1998).

The peregrine falcon *(Falco peregrinus anatum)* is a former federally listed as endangered species, recently delisted, that is a fall and spring migrant through the NRC. The bald eagle is a federally listed as threatened species that is a migrant and winter visitor primarily in the Pahranagat Valley area. The mountain plover

(Charadrius montanus) is a candidate species for federal listing that may occur within the NRC as a migrant.

The Mexican spotted owl *(Strix occidentalis lucida)* and the Utah prairie dog *(Cynomys parvidens)* are federally threatened species that may both occur in the Utah portion of the NRC where they are also listed as threatened by the state of Utah.

The spotted bat *(Euderma maculatum)* is listed by the state of Nevada as threatened. It may occur within the NRC.

Sensitive Habitats. There are several types of wetlands found in the ROI including salt and brackish water marshes, seeps and springs, riparian (stream) areas, mesquite thickets, and man-made water sources (Bureau of Land Management, 1980; Nellis Air Force Base, 1994; and Nellis Air Force Range, 1996a).

Natural springs are found in nearly all the mountainous areas of the NAFR (Nellis Air Force Base, 1996a). The NAFR contains six areas identified by the USFWS and the state of Nevada as wetlands. These wetlands occur in Railroad Valley/Duckwater Wildlife Management Area (WMA), White River Kirch WMA, Pahranagat/Key Pittman WMA, Spring Valley, Meadow Valley Wash, and Muddy River/Warm Springs (Nellis Air Force Base, 1994).

Critical habitats for five protected fish species are present at the NAFR and are localized to certain washes and springs and their associated outflows.

Areas of significant topographical relief occur throughout the ROI. These areas provide nesting habitat for raptors (i.e., birds of prey, such as prairie falcon and golden eagle), as well as shelter sites for many mammalian species including little brown bat, mountain lion, and bighorn sheep.

No unique or high-ranking vegetation formations have been identified on the NAFR (Nellis Air Force Base, 1994). However, this may be the result of a lack of quantifiable data and field sampling and verification.

3.4.4 Cultural Resources

Cultural resources are districts, sites, structures, artifacts, or any other tangible or intangible aspect of human activity considered important to a culture, subculture, or community for scientific, traditional, religious, or other reasons. Cultural resources can be characterized as prehistoric resources, historic resources and structures, and traditional resources, which can include traditions, belief, practices, lifeways, arts, crafts, and social institutions of any community, be it a Native American tribe, a local ethnic group, or the people of a nation as a whole.

Numerous laws and regulations require that possible effects to cultural resources be considered during the planning and execution of federal undertakings. These

laws and regulations stipulate a compliance process, define the responsibilities of the federal agency proposing the undertaking, and delineate the relationship among other involved agencies (e.g., the SHPO and the Advisory Council on Historic Preservation [Council]). The primary law relating to historic resources is the NHPA; of particular concern are Sections 106, 110, and 111 of the NHPA. Only cultural resources meeting the established criteria requirements for inclusion in the National Register of Historic Places (National Register) (36 CFR Part 60.4) are afforded the protection of this legislation.

Area of Potential Effect

The area of potential effect (APE) (synonymous with the concept of ROI) for the Proposed Action encompasses areas that could be affected by noise, including sonic booms from aircraft overflights. The APE includes the land area that lies beneath the R-2508 Complex and the HASC in California, and the NRC in Nevada and Utah. No ground-disturbing activities would take place under the Proposed Action.

In order to identify the cultural resources that are encompassed by the APE and to determine the types of resources that might be affected by noise or vibration from overflights, a qualitative study was performed to identify the types of resources found within the possible affected terrain. In addition, the Native American Heritage Commission and the environmental management divisions of Edwards and Nellis AFBs were also consulted. More than 8,000 sites were identified within the R-2508 Complex and nearly 2,000 in the NRC. However, this APE is vast, large areas are rugged and remote, and much of the area has not been surveyed; therefore, there is a high probability that additional sites remain unrecorded.

Types of Cultural Resources

As stated previously, cultural resources may include prehistoric, historic, and traditional resources. These are described in the following paragraphs.

Prehistoric Resources. Prehistoric resources are any type of activity site, object, or feature belonging to or associated with aboriginal cultural groups prior to European contact. Although Native American groups continued to inhabit the region during European occupation, the number of sites and population densities were severely diminished.

Historic Resources. For purposes of this analysis, historic resources are the remnants of an activity conducted between the time of European contact and the present day. The resources typically encountered are mining features, railroad construction camps, homesteads, cabins, military features, and similar components. Historic resources have been further divided into nonmilitary structures and military structures for readability.

Traditional Resources. Traditional resources can include archaeological sites, burial sites, ceremonial areas, caves, mountains, water sources, trails, plant

habitat or gathering areas, or any other natural area important to a culture for religious or heritage reasons. Significant traditional sites are subject to the same regulations and afforded the same protection as other types of historic properties. Traditional sites identified would be attributed to indigenous Native American groups; no traditional sites associated with any other cultural group (e.g., Chinese, African-American) have been identified.

3.4.4.1 Edwards Air Force Base.

Nearly 8,000 sites have been identified within the R-2508 Complex. Site types present beneath the R-2508 Complex include petroglyph and pictograph panels, historic and prehistoric encampments, artifact scatters, historic adobe and non-adobe structures with standing walls, and historic mines and wells.

Prehistoric Resources. Over 5,000 prehistoric sites have been identified within the R-2508 Complex. Site types include lithic scatters, food processing stations, quarries, temporary camps, rock shelters, trails, rock alignments, petroglyphs, and pictograph sites. Five sites and districts have been listed in the National Register. These are the Squaw Spring Archaeological District, Fossil Falls Archaeological District, Last Chance Canyon, Big and Little Petroglyph Canyon National Historic Landmark, and Bitter Spring. At least 25 additional sites are currently considered eligible for the National Register, but others are expected to be nominated as more information becomes available (U.S. Army Corps of Engineers et al., 1997).

Historic Resources. Over 2,600 historic structures have been identified in the R-2508 Complex. Nonmilitary and military historic resources are described in the following paragraphs.

Nonmilitary Structures. Edwards AFB contains numerous historic resources ranging from town sites, homesteads, and ranches to mines, mining camps, rail camps, and refuse concentrations. A large percentage of the historic resources within Edwards AFB and the R-2508 Complex are historic homesteads dating between 1880 and 1930. Of the 625 homesteads recorded within Edwards AFB, 11 have been found to be potentially eligible for the National Register; however, SHPO concurrence has not yet been received. Eighteen historic resources within the R-2508 Complex have been listed in the National Register. These include the Twenty Mule Team Road, Death Valley Scotty Historic District, Eagle Borax Works, Harmony Borax Works, Panamint City, the Manzanar War Relocation Center National Historic Landmark, the Saline Valley Salt Tram Historic Structure, and the remains of the town of Skidoo. Another 22 historic resources have been determined eligible for the National Register, and additional sites are likely to be added after completion of additional research (U.S. Army Corps of Engineers et al., 1997).

Military Structures. The Air Force mission and Man in Space themes at Edwards AFB will continue to play an important role in the nation's history. Presently, 112 buildings constructed and used throughout the Cold War era are under investigation and evaluation for eligibility to the National Register. None have been formally listed to date.

The only property currently listed in the National Register is Rogers Dry Lake for its role in the Man in Space thematic context. In 1990, the dry lake bed was listed in recognition of its nearly 50 years of supporting test and development activities that eventually led to the Space Shuttle's historic flight.

Traditional Resources. Literature and site record reviews indicate that a number of the archaeological sites identified within the APE contain components (e.g., burials) considered to be sacred or have religious significance to Native Americans. Although traditional sites may be contained within the APE, it is common practice for Native Americans to conceal their locations in order to protect these types of sites, causing the numbers and locations of these sites to be underreported. In compliance with 36 CFR Part 800.4(a)(iii), and in order to ensure that any sites of traditional cultural value are identified and adequately considered under the Proposed Action, the Air Force must consult with representatives from the potentially interested tribes.

3.4.4.2 Nellis Range Complex.

Archaeological sites beneath the NRC are similar in composition to those described for the R-2508 Complex.

Prehistoric Resources. Within the past 60 years, over 2,000 prehistoric sites have been identified within the NRC. The sites consist of petroglyphs, lithic scatters, rock shelters, temporary camps, milling stations, and aboriginal trails. In 1977, the Tim Spring Petroglyph Site was recorded and listed in the National Register. It is the only site currently listed in the NRC. Due to the size of the installation and the lack of development, it is likely that additional sites will be determined eligible and included in the National Register at a later date (Air Combat Command, 1998).

Historic Resources. Over 110 historic sites have been identified on the NAFR. These historic resources primarily comprise mining and ranching.

Nonmilitary Structures. Most of the nonmilitary sites within the NRC are related to the historic mining activities that once existed in the area. Historic site types include mines, town sites, mining camps, railroad camps, and ranches. Many of the buildings have been used for military training exercises and are now destroyed. To date, no nonmilitary historic sites have been found to be eligible for inclusion in the National Register. However, because of the dry desert climate and remote location of many of these sites, it is likely that some retain a high degree of integrity, and future studies may identify National Register-eligible sites (Air Combat Command, 1998).

Military Structures. Studies to identify National Register-eligible military structures have been conducted for the NAFR, but results of a historic building and Cold War material study, which included the Tonopah Test Range Air Force Auxiliary Field, have not yet been finalized (Air Combat Command, 1998).

Traditional Resources. The discussion of traditional resources presented in Section 3.4.4.1 is also applicable to the NRC.

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4.0 ENVIRONMENTAL CONSEQUENCES

This chapter presents the results of the analysis of potential environmental effects of implementing the F-22 IOT&E activities. Changes to the natural and human environments that may result from the F-22 IOT&E were evaluated relative to the existing environment, as described in Chapter 3.0. For each environmental component, anticipated direct and indirect effects were assessed. The potential for significant environmental consequences was evaluated utilizing the context and intensity considerations, as defined in CEQ regulations for implementing the procedural provisions of NEPA (40 CFR Part 1508.27).

4.1 LAND USE

An impact to land use would be considered significant if one or more of the following would occur as a result of the Proposed Action: conflict with applicable ordinances and/or permit requirements; nonconformance with applicable lands use plans; preclusion of use of properties being used for existing activities; or conflict with established uses of an area. Under the Proposed Action, noise from F-22 ground operation activities at Edwards AFB and F-22 overflights and sonic booms in the airspace complexes represent a potential impact to land use.

To assess the potential land use impacts from the Proposed Action, the noise analysis impacts were reviewed to identify any increase in noise levels to which sensitive land use areas would be exposed.

4.1.1 Edwards Air Force Base

On-base land use conflicts are not expected. F-22 IOT&E activities would not include any construction of new facilities or modification to existing facilities and would not result in any changes to existing on-base land use. F-22 IOT&E activities would primarily occur in facilities already supporting the F-22 program. Other facilities that would support IOT&E would be used for types of activities that routinely occur in the facility.

Existing land uses in the vicinity of the F-22 CTF site generally support industrial and aircraft-related operations (see Section 3.1.1). Although facilities and areas adjacent to the CTF site may be exposed to high noise levels (see Section 4.4.2.1), F-22 IOT&E activities would be consistent with the current land uses. F-15 aircraft were formerly stationed at the F-22 CTF facilities; F-15 aircraft are now stationed at another location on Edwards AFB. Noise levels produced by the F-22 in this area would be similar to those that were produced by the F-15 aircraft when they were at the F-22 CTF. Because there would not be a significant change in the noise environment, impacts to land use around the CTF would not be expected.

F-22 engine maintenance runup activities are conducted in the Test Cell and the Hush House which are specifically designed for these types of activities. These facilities are also located far away from the general work force and areas with uncontrolled access. Personnel working outdoors along Taxiway E would be exposed to some of the F-22's runup activity noise. However, their exposure would be well below the 1 hour 81dBa exposure limit. Thus, noise levels generated would be within existing noise levels, and no impacts to land use would occur.

All F-22 IOT&E flight activities would occur within existing military use airspace and comply with all applicable airspace usage restrictions. These restrictions including low-altitude avoidance and noise-sensitive areas are identified in AFFTC Instruction 11-1. Therefore, there would be no impacts to any land uses within the R-2508 Complex and HASC airspaces from changes in aircraft overflights. F-22 overflights would not result in a significant change to noise levels or sonic boom frequency or intensity (see Section 4.4.2.1). Therefore, no impacts to land uses due to changes in noise levels would be expected in the R-2508 Complex and HASC.

4.1.2 Nellis Range Complex

All F-22 IOT&E flight activities would occur within existing military use airspace and comply with all applicable airspace usage restrictions. These restrictions including low-altitude avoidance and noise-sensitive areas are identified in Nellis AFB Supplements to AFI 13-212, Volume l Weapons Ranges and Volume II Weapons Range Management for various areas. These areas are located both within and adjacent to NRC. FAA rules also state that all aircraft must avoid persons, vehicles, and structures by 500 feet. Military pilots are instructed to avoid these locations by horizontal and vertical distances to enhance flight safety, noise abatement, and environmental sensitivity. Therefore, there would be no impacts to any land uses within the NRC due to changes in aircraft overflights. F-22 overflights would not result in a significant change to noise levels (see Section 4.4.2.2). Therefore, no impacts to land uses due to changes in noise levels would be expected in the NRC.

Sonic booms may increase in frequency on the NRC from F-22 IOT&E activities. Existing restrictions limiting supersonic flights over populated areas would minimize sonic boom levels experienced by residents on the NRC.

4.2 AIRSPACE

The airspace assessment analyzes the capability of the affected airspace elements to accommodate projected flight activities and determines whether such changes would have an adverse effect on overall use of airspace within the ROI. This includes consideration of factors such as the interaction of the proposed activity with other operations within the specific airspace as well as possible adverse effects on other nonparticipating aircraft operations in or near the airspace involved in the Proposed Action. Since there are no proposed changes to the actual airspace designations, the analysis compares the total projected flight

activity for the F-22 and other aircraft against the historic flight activity generated by commercial, general, and military aviation aircraft. Section 3.2 indicated that historic flight activity includes the sorties conducted for DT&E and OT&E for completed test programs such as the F-4, F-15, F-16, and other aircraft; the number of sorties projected for F-22 IOT&E program does not represent an additional requirement but replaces the sorties conducted for the completed IOT&E programs. Therefore, sorties projected for the F-22 and its support aircraft such as chase planes, tankers, and AWACS have, in essence, already been captured in the airspace utilization baselines. Instead, the total projected activity is compared against the historic airspace utilization baseline range to determine if the upper limit of the baseline range is exceeded. F-22 sortie information is presented in this section to show where and how often the F-22 will be flying in the R-2508 Complex and NRC. This information is used in other sections such as Section 4.4.2, Noise, for analysis purposes.

4.2.1 Edwards Air Force Base

The F-22 IOT&E would result in 204 F-22 sorties in the R-2508 Complex airspace, and an additional 531 sorties that would transit Edwards AFB airspace en route to the NRC. All F-22 IOT&E flight activity would take place within existing airspace and existing airspace usage parameters within the R-2508 Complex, including the Black Mountain Supersonic Corridor, and the HASC. The Proposed Action would not result in modifications to any existing airspace areas or usage parameters. Overall, as described in Section 3.2.1, annual usage of the R-2508 Complex airspace has declined in recent years with the end of the Cold War and the subsequent reduction in military activity. Even when the F-22 IOT&E flight activity is included, the annual projected usage would still be below the 70,000 to 90,000 sorties that occurred during the late 1980s. Current baseline conditions for the R-2508 Complex are approximately 54,000 sorties annually. Assuming all F-22 IOT&E sorties, including those that would transit to the NRC, would be an increase over expected baseline conditions, there would be a 1-percent increase in sorties. No airspace impacts would be expected to occur as a result of the proposed F-22 IOT&E flight testing activity.

4.2.2 Nellis Range Complex

As with the impacts associated with the use of the R-2508 Complex at Edwards AFB, all F-22 IOT&E flight activity at the NRC would take place within existing airspace and airspace usage parameters. The Proposed Action would not result in any modifications to any existing airspace areas or usage parameters. Annual usage of the NRC airspace has varied in recent years from 200,000 to 300,000 sortie operations annually. The 531 F-22 sorties that would occur within the NRC would equal approximately 5,310 F-22 sortie operations. The F-22 IOT&E sortie operations would represent 2 to 3 percent of the current sortie operations in the NRC. Total annual sortie operations would remain between 200,000 and 300,000. No airspace impacts would be expected to occur as a result of the proposed F-22 IOT&E flight testing activity.

F-22 IOT&E flight activities that would occur in nonmilitary use airspace include transition flights between the R-2508 Complex and the NRC. These are routine types of activities that occur through coordination with the FAA and would not entail a change in existing airspace usage or designation. No impacts to nonmilitary airspace would be expected from these activities.

4.3 HAZARDOUS MATERIALS AND HAZARDOUS WASTE MANAGEMENT

4.3.1 Hazardous Materials Management

4.3.1.1 Edwards Air Force Base.

In general, the hazardous materials requirements for the F-22 would be similar to those for other aircraft that are already present on Edwards AFB. Edwards AFB has experience handling a greater variety of hazardous materials used on a flightline than a typical Air Force base, because it supports a large aircraft inventory and a number of flight test programs. Existing management programs and procedures for storage and use of these materials would accommodate the requirements of the F-22. An HDSC Operating Instruction is currently in the process of being established for the F-22 program at Edwards AFB and would be in place prior to initiation of IOT&E activities. The HDSC Operating Instruction will incorporate the requirements of the F-22 program into the Edwards AFB HAZMART system, and all F-22 program personnel will be trained in the use of the HDSC. No impacts to hazardous materials management at Edwards AFB would be expected from F-22 IOT&E activities.

4.3.1.2 Nellis Air Force Base.

Contingency or emergency F-22 aircraft operations at Nellis AFB may require use of minimal amounts of hazardous materials. Any hazardous materials used would be existing materials at Nellis AFB; no F-22 program-specific hazardous materials would be maintained at Nellis AFB as part of the F-22 IOT&E. No new hazardous materials management plan would be developed at Nellis AFB for the F-22 IOT&E. No impacts to existing hazardous materials management programs at Nellis AFB would be expected as a result of implementing the F-22 IOT&E.

4.3.2 Hazardous Waste Management

4.3.2.1 Edwards Air Force Base.

As described in Section 4.3.1.1, and because some hazardous materials previously identified for the F-22 program have been replaced with less or nonhazardous substances, the types and amounts of hazardous waste generated by F-22 IOT&E activities would be expected to be generally less than the types and amounts identified in the Advanced Tactical Fighter Full-Scale Development Environmental Assessment (U.S. Air Force, 1991). Use of the HAZMART system on Edwards AFB to reduce usage of hazardous materials and generation of waste would also reduce the quantity of hazardous waste generated. The HDSC

Operating Instruction for the F-22 program will include a spill plan and an individual hazardous waste accumulation point plan for managing hazardous waste generated by the F-22 program. The Edwards AFB Hazardous Waste Management Plan would be revised to incorporate F-22 hazardous waste generation. No impacts to hazardous waste management would be expected at Edwards AFB from anticipated F-22 IOT&E activities.

In the event of an F-22 aircraft mishap, emergency response personnel could be exposed to damaged or burning composite materials in the aircraft. This hazard would be similar to that posed by existing aircraft constructed with composite materials. Base personnel that would respond to an emergency (fire department, flight surgeon, and bioenvironmental engineering) have been made aware of the potential hazard posed by an F-22 accident. These personnel are already familiar with the hazards associated with a composite aircraft mishap and are trained in aircraft crash and recovery efforts. F-22 program personnel would be responsible for actual recovery, handling, and disposal of aircraft material. These personnel would receive training in the Crash Emergency Response and Recovery Plan that will be developed for the F-22 aircraft. A toxicity burn study will be conducted on F-22 composite material, and the results will be incorporated into the Crash Emergency Response and Recovery Plan.

4.3.2.2 Nellis Air Force Base.

Contingency or emergency F-22 aircraft operations at Nellis AFB would generate minimal amounts, if any, of hazardous waste. No additional hazardous waste plan would be developed at Nellis AFB for the F-22 IOT&E. No impacts to existing hazardous waste management programs would be expected at Nellis AFB.

4.3.3 Ordnance

4.3.3.1 Edwards Air Force Base.

F-22 aircraft would carry live munitions, chaff, and flares during IOT&E flight tests. These materials would be loaded onto the aircraft at Edwards AFB. Ordnance used on the F-22 aircraft would be similar to that currently handled at Edwards AFB. These types of materials are routinely handled by Edwards AFB personnel. Ordnance would be handled in accordance with existing DOD, Air Force, and base regulations. No impacts to ordnance management at Edwards AFB would be expected from F-22 IOT&E activities.

4.3.3.2 Nellis Range Complex.

F-22 aircraft would dispense chaff and flares over the NRC during IOT&E test flights. A study of the environmental effects of chaff and flares generally found no significant adverse effects from chaff use (U.S. Air Force Air Combat Command, 1997). Release of chaff and flares would occur within existing range guidelines, as described in Section 3.3.3.2. Because the F-22 aircraft would remain above 3,000 feet AGL, release of flares would occur at much higher altitudes than the

minimum altitudes allowed for these activities on government land (see Section 3.3.3.2). During F-22 IOT&E, chaff and flares would be released from a maximum of four F-22 aircraft during a 5- to 7-month period and in areas where these activities routinely occur. This chaff and flare usage would not result in a significant change in the types and amounts of these materials released within the NRC; therefore, no significant impacts to the environment from ordnance would be expected.

4.4 NATURAL ENVIRONMENT

4.4.1 Air Quality

Air quality impacts associated with the IOT&E phase of the F-22 program would primarily occur from increased aircraft, AGE, and privately owned vehicle (POV) emissions. Increased aircraft emissions would result from (1) engine testing, (2) landings and takeoffs (LTOs), and (3) flights performed by F-22 aircraft. The F-22 would use JP-8, which has a lower sulfur content than JP-4. Emissions from these sources are quantified. Some increase in air emissions would also occur from increased activity (e.g., repair, maintenance, painting, solvent use) at various support shops and base facilities. However, these emissions would be negligible in comparison to overall base activity emissions and, therefore, are not quantified.

4.4.1.1 Edwards Air Force Base.

Air emissions resulting from the Proposed Action within the Edwards AFB ROI include those from F-22 aircraft engine testing, LTOs, and flights; from AGE used to support the F-22 aircraft; and from POVs associated with the increased personnel required for F-22 IOT&E. These emissions are summarized in Table 4-1. Emissions from F-22 engine testing, LTOs, and flights associated with the F-22 IOT&E were calculated using engine emission factors specific to each potential engine operating mode, as obtained from Table E-1 of the U.S. Air Force Air Conformity Applicability Model, Version 2.0 LT (U.S. Air Force, 1996). Engine emission factors were multiplied by (1) the total number of operations expected to occur during the testing program, (2) the number of engines operating during a particular operation, and (3) the time duration in each engine mode for the particular operation. Details of the calculations by aircraft type and engine mode are provided in Appendix D (Tables D-1 through D-4).

AGE emissions were calculated using emission factors obtained from Table H-1 of the U.S. Air Force Air Conformity Applicability Model, Version 2.0 LT. The emission factors were provided in units of kilograms per aircraft LTO. Therefore, total AGE emissions were calculated as the summation of individual aircraft LTOs multiplied by the aircraft-specific emission factors. Details of the AGE calculations for the F-22 are provided in Appendix D (Tables D-6 and D-7).

The additional personnel required for F-22 IOT&E activities at Edwards AFB would result in an increase of approximately 100 employees during 2002. Emissions from increased POV mileage associated with this personnel increase were

estimated from inventory information provided in the Edwards AFB Clean Air Act General Conformity Analysis (U.S. Air Force, 1995) and EMFACT7F1.1 emission rates for mobile sources. These are required when completing a conformity determination in the state of California. Details of the POV emission calculations are provided in Appendix Table D-8. These estimates are likely to be overestimates, since actual vehicle emissions tend to decrease from year to year as newer, more efficient emission controls are enacted. CO, sulfur oxides (SO_x), and PM_{10} emission inventory data were not available. However, the ROI for Edwards AFB is in attainment of CO and SO_2 standards; small increases in these

Table 4-1. Proposed Action Emissions Summary for Edwards Air Force Base, R-2508 Complex, and High-Altitude Supersonic Corridor

	Emissions (tons)				
Source	CO	VOC	NO_x	SO_x	PM
F-22 Engine Test Runs[(a)]	41.47	11.54	11.42	0.19	0.60
F-22 LTOs[(b)]	41.23	19.76	10.58	0.04	0.20
F-22 Airspace Operations[(c)]	356.00	87.49	209.49	2.07	7.29
AGE	0.20	0.03	0.13	0.02	0.01
POVs	28.10	2.50	3.60	0.10	24.90
Total for all sources	467.00	121.32	235.22	2.42	33.00

Notes: (a) Emissions from permitted sources (Test Cell and Hush House).
(b) Includes taxi/idle (out), takeoff, climbout, approach, and taxi/idle (in) emissions that occur below 3,000 feet AGL.
(c) Includes emissions above 3,000 feet AGL from F-22 flights in the R-2508 Complex and HASC airspace only.

AGE = aerospace ground equipment
CO = carbon monoxide
HASC = High-Altitude Supersonic Corridor
LTO = landing and takeoff
NO_x = nitrogen oxides
PM = particulate matter
POV = privately owned vehicle
SO_x = sulfur oxides
VOC = volatile organic compound

emissions from mobile sources resulting from increased employment would not jeopardize this status.

An air conformity applicability analysis was conducted for the Proposed Action. Based upon the "serious" ozone nonattainment status of the Kern County portion of Edwards AFB, the Proposed Action would conform to the most recent EPA-approved SIP if the total direct and indirect emissions remain below de minimis thresholds established in the U.S. EPA's conformity rule for general federal actions. The de minimis emissions thresholds are 50 tons per year of NO_x and VOCs. Kern County is in attainment of the NAAQS for PM_{10}; however, the MDAB (including Kern County) is in nonattainment for PM_{10} for state standards, with several monitoring locations in Kern County exceeding California standards (50 $\mu g/m^3$). The de minimis emissions threshold for PM_{10} is 100 tons per year.

Emissions subject to conformity applicability analysis from aircraft LTOs, AGE, and POV sources are summarized in Table 4-2. Maintenance engine runs would be performed inside currently permitted facilities (Hush House, Facility 1735, Test Cell, Facility 1899). Emissions from permitted sources are not subject to conformity applicability analysis (40 CFR Part 93 Subpart B). Emissions from aircraft operating in airspace above 3,000 feet AGL were not included because these emissions would (1) be released above the mixing height and effectively blocked from dispersion to the surface, or (2) be released from such a height and

over such a vast area that ground-level concentrations resulting from downward dispersion would be negligible.

Table 4-2. Conformity Applicability for Emissions Sources Associated with the F-22 IOT&E Program at Edwards AFB

	Emissions (tons)				
Emissions Source	CO	VOC	NO_x	SO_x	PM
F-22 Aircraft LTOs[(a)]	41.23	19.76	10.58	0.04	0.20
AGE	0.20	0.03	0.13	0.02	0.01
POVs	28.10	2.50	3.60	0.10	24.90
Total	69.53	22.29	14.31	0.16	25.11
De minimis Thresholds	N/A	50.000	50.00	N/A	100.00
Kern County, MDAB portion, Inventory[(b)]		4,946	14,231		17,328
Percentage of Inventory		0.004	0.001		0.001

Notes: (a) Does not include emissions from flight activity above 3,000 feet AGL, or emissions resulting from testing in permitted buildings.
(b) Source: Kern County Air Pollution Control District, Reasonable Further Progress Plan, (Post-1996 Rate of Progress Plan) 1994

AGE = aerospace ground equipment
CO = carbon monoxide
MDAB = Mojave Desert Air Basin
N/A = not available
NO_x = nitrogen oxides
PM = particulate matter
POV = privately owned vehicle
SO_x = sulfur oxides
VOC = volatile organic compound

The area that would be affected by the emissions shown in Table 4-2 is the immediate area around Edwards AFB, situated in the MDAB portion of Kern County. The Valley portion of Kern County, situated in the San Joaquin Air Pollution Control District, is not included in the conformity applicability analysis. This area is not anticipated to be affected based on flight patterns out of Edwards AFB. Table 4-2 indicates that the ozone precursor (VOC and NO_x) emissions and PM_{10} emissions would be less than the de minimis thresholds of 50 tons per year for a serious ozone nonattainment and 100 tons per year for PM_{10} nonattainment areas such as the current MDAB portion of Kern County (40 CFR Part 93 Subpart 153[b][2]). In addition, the emissions of ozone precursors and PM_{10} would not exceed 10 percent of the total Kern County inventories of VOCs or NO_x (40 CFR Part 93 Subpart 153 [i]). Based on the conformity applicability criteria, the Proposed Action conforms with the most recent EPA-approved SIP, and further detailed conformity analysis is not required.

There are no local concerns for CO within the ROI. Emissions from the Proposed Action would not result in any CO hotspots, since traffic congestion in the ROI and current CO nonattainment are not local issues.

The impact of air emissions on visibility is an issue with regard to federal Class I areas, such as national parks and wilderness areas. It occurs whenever, any impairment of visibility in the Class I area is caused by manmade air pollution. This

includes all types of sources and activities emitting pollutants such as stationary (factories), mobile (cars), and area sources (road dust). 40 CFR Part 51 "Regional Haze Regulations" or standards on visibility impairment for Class I areas took effect on August 30, 1999, however, state implementation plans will not be available any earlier than December 31, 2003 for attainment areas or December 31, 2006 for non-attainment areas. Consequently, the standards and guidance will not take effect until after the F-22 IOT&E program ends (spring of 2003).

Based on the information on hand it is projected that F-22 flight operations within the R-2508 Complex Class I areas would only minimally increase air pollutants compared to baseline conditions within project airspaces. There are four Class I areas located within the R-2508 Complex they are Dome Land Wilderness Area (USFS manager), John Muir Wilderness Area (USFS manger), Kings Canyon National Park (NPS manager), and the Sequoia National Park (NPS manager). The proposed project would add only a 1-percent increase in sorties to the approximately 54,000 baseline sorties currently occurring in the R-2508 Complex airspace. This would indicate that regional visibility reductions from the Proposed Action would also be minimal and not appreciable.

4.4.1.2 Nellis Range Complex.

Emissions in the NRC from F-22 flights were calculated in the same manner as those described in Section 4.4.1.1 for the Edwards AFB ROI. The resulting emissions are summarized in Table 4-3.

Table 4-3. Emissions in Nellis Range Complex from F-22 Aircraft Operations Associated with the F-22 IOT&E Program

Emissions (tons)				
CO	VOC	NO_x	SO_x	PM
8,312.95	1,778.93	807.64	49.77	127.33

CO = carbon monoxide
IOT&E = Initial Operational Test and Evaluation
NO_x = nitrogen oxides
PM = particulate matter
SO_x = sulfur oxides
VOC = volatile organic compound

The F-22 flights within the NRC would occur at an altitude above 3,000 feet AGL during a 9- to 11-month period. All F-22 flights in the NRC would originate and terminate at Edwards AFB and would only use Nellis AFB for emergency landings. Emergency landing ambient air emissions (below 3,000 feet) are not included in the analysis since they are not reasonably foreseeable emissions and cannot be "practicably" controlled, as defined in 40 CFR Part 93.152. Details of the calculations for the F-22 by engine-mode are provided in Appendix D (Tables D-1 and D-5).

No additional personnel are assumed to be required at Nellis AFB for the F-22 IOT&E program. Therefore, no additional POV emissions would be generated.

Upper atmosphere increases in emissions would result from approximately 5,310 sortie operations, which would represent 2 to 3 percent of the current 200,000 to 300,000 sortie operations that currently occur in the NRC. Emissions from F-22 flights above 3,000 feet would be (1) released above the mixing height and effectively blocked from dispersion to the surface, or (2) released from such a height and over such a vast area that ground-level concentration resulting from downward dispersion would be negligible. These emissions would be below the PSD significance thresholds for attainment areas.

Conformity applicability does not apply to attainment areas or to emissions in the upper atmosphere. Clark County is the only nonattainment area in the NRC ROI. Because Clark County is a "serious" CO and PM_{10} nonattainment area with regard to the NAAQS, the Proposed Action would conform to the most recent EPA-approved SIP, if the total direct and indirect emissions remain below de minimis thresholds established in the U.S. EPA's conformity rule. Because all emissions associated with the Proposed Action would occur above 3,000 feet, there would not be any impact on local air quality, and conformity would not apply. Emissions from emergency landing actions are exempt from conformity, since emergency landings are not reasonably foreseeable actions. Based on the applicability criteria, further detailed conformity analysis is not required.

The impact of project aircraft emissions on visibility may be an issue with regard to federal Class I areas, such as national parks and wilderness areas, where any appreciable deterioration in air quality is considered significant. No Class I areas are beneath the NRC. However, the northeastern corner of Death Valley National Park is approximately 15 miles from the western boundary of the NRC. The IOT&E test program would only minimally increase air pollutants compared to existing upper atmosphere baseline conditions within the range. The proposed project would represent 2 to 3 percent of the baseline sortie operations in the NRC. This would indicate that regional visibility reductions from the Proposed Action would also be minimal and not appreciable. Impacts on visibility within Class I areas from the Proposed Action would therefore be insignificant.

4.4.2 Noise

Environmental effects related to noise include the potential effects on the local human and animal populations. This analysis compares the noise levels generated by the F-22 with those of aircraft in the existing fleet and with existing noise standards and criteria. Units used to evaluate noise effects are described in Section 3.4.2, Noise. Aspects used to quantify the effects of noise used in this analysis include land use compatibility, hearing loss, and sonic boom annoyance. These are described in the following paragraphs.

Land Use Compatibility. Estimates of total noise exposure resulting from aircraft operations, as expressed using DNL, can be interpreted in terms of the

compatibility with designated land uses. The Federal Interagency Committee on Urban Noise developed land use compatibility guidelines for noise (U.S. Department of Transportation, 1980). Based upon these guidelines, suggested compatibility guidelines for evaluating land uses in aircraft noise exposure areas were developed by the FAA and the Air Force. The California Department of Health, Office of Noise Control (California Office of Planning and Research, 1987), has also developed land use compatibility guidelines. Both federal and California guidelines are presented in Table 3-11. The land use compatibility guidelines are based upon annoyance and hearing loss considerations. Compatible or incompatible land use is determined by comparing the predicted DNL level at a site with the recommended land uses. Land use compatibility guidelines for sonic booms have not been developed by the Air Force.

Hearing Loss. Under AFOSH Standard 48-19, workers may be exposed to an 8-hour noise level of 85 A-weighted dB, with exposure times halved for each 3-A-weighted dB increase in exposure, up to a maximum of 115 A-weighted dB for 30 seconds. Noise levels above 65 A-weighted dB are unsatisfactory for interior offices according to AFOSH Standard 48-19. For nonoccupational conditions, such as walking on streets adjacent to a noise source, limiting exposure time is 81 A-weighted dB for 1 hour. This nonoccupational guideline is derived from the threshold limit values of the National Institute for Occupation Safety and Health, U.S. Department of Health and Human Services. These criteria were developed to provide the basis for comprehensive safety and health standards.

Sonic Booms. Supersonic test operations in the designated supersonic airspace corridors cannot be conducted without occurrence of sonic booms. AFFTC aircraft performing supersonic test missions exceed the speed of sound from one to three times per flight. Supersonic flight above 30,000 feet is generally unrestricted over the continental United States. Below 30,000 feet, supersonic operations are restricted to remote and desolate areas to minimize potential damage to structures as shown in Table 3-13. Annoyance to sonic boom exposures can be estimated based upon the information provided in Table 3-12. Although the Air Force has not established a level of significance for sonic booms, exposures below CDNL 61 dB are considered acceptable (National Academy of Sciences, 1977).

Assumption. Noise levels for the F-22 are based upon F-15C modeling results. Preliminary noise measurements on an EMD F-22 were performed by the Armstrong Laboratory Noise Effects Branch in 1997. The noise levels were found to be comparable to the F-15C engine noise data, with some spectral differences.

4.4.2.1 Edwards Air Force Base.

This section includes a discussion of noise impacts on Edwards AFB and in the R-2508 Complex and HASC areas.

On-Base Noise. This section discusses noise impacts from aircraft operations and from ground run-up and engine maintenance activities at Edwards AFB.

Aircraft Operations. The Proposed Action would add approximately 735 F-22 sorties from Edwards AFB, or 1,470 operations. The increase of 1,470 operations represents a less than 2-percent increase in the annual operations from Edwards AFB. A 2-percent increase in operations for similar types of aircraft would result in a less than 0.1-dB increase in DNL. The current 65-dB CNEL contour is contained entirely within the Edwards AFB boundaries, as shown in Figure 3-8. A 0.1-dB increase in the DNL would not result in a significant change to the existing noise contours, and the 65-dB CNEL contour would remain within the base boundary. In addition, this increase would be less than the 2-dB DNL increase threshold that necessitates updating an AICUZ study.

An analysis of the addition of an "F-22-like" test program at Edwards AFB was conducted for the Environmental Assessment for the Continued Use of Restricted Area R-2515 (Air Force Flight Test Center, 1998). The analysis indicated that noise levels would increase 6 percent but that no significant impacts would be expected. Noise modelling conducted for that analysis indicates that the 65-dB CNEL noise contour would remain within the base boundaries. This analysis assumed a 5- to 6-year test program that would include basing up to 11 F-22 aircraft and conducting an additional 6, 719 F-22 and F-16 annual operations at Edwards AFB. F-22 IOT&E would generate approximately 1,558 F-22 and F-16 operations at Edwards AFB over an 11 to 12-month period. Noise levels from F-22 IOT&E activities would therefore be less than those analyzed in the R-2515 EA. Therefore, no significant impacts to the noise environment on Edwards AFB would be expected from F-22 IOT&E activities.

Ground Run-up and Engine Maintenance. As with all aircraft, pre-flight checks and routine engine maintenance would be conducted on the F-22. Before each sortie, pre-flight check activities would occur at the CTF area near Hangars 1881, 1874, and 1870, southeast of the intersection of Wolfe and Forbes avenues (see Figure 2-3). These pre-flight checks include approximately 30 minutes at idle for engines to stabilize and for inspections before the aircraft taxis to the runway.

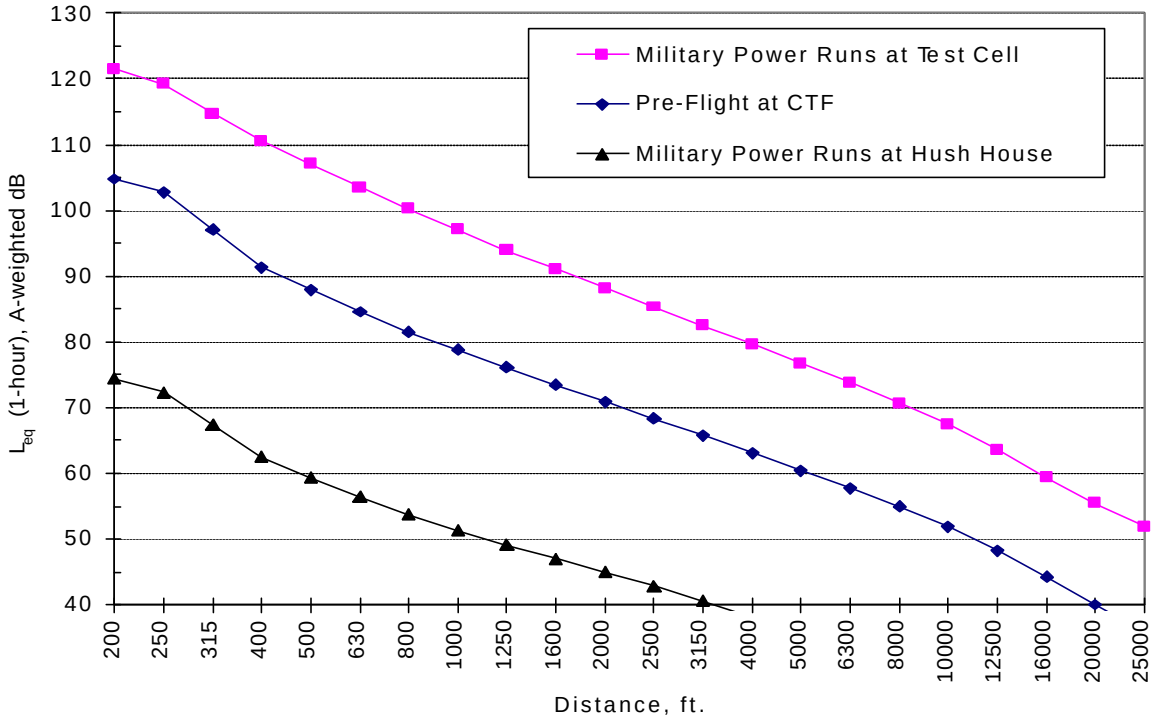
The Test Cell (Facility 1899), approximately 1,800 feet east of Wolfe Avenue, would be used for leak checks and military power runs of the F-22 engines while installed in the aircraft.

Uninstalled or installed engines would be tested in the Hush House (Facility 1735). The noise levels during these operations would be reduced by the Hush House.

Total engine test runs for the F-22 IOT&E would be approximately 428. This would represent a 2-percent increase over the 17,876 engine test runs conducted at Edwards AFB in 1996 (see Table 3-14).

Noise levels at these locations from F-22 operations would be similar to existing F-15 activities. Estimated 1-hour noise exposures from the F-22 aircraft during pre-flight activity at the CTF, for military power runs at the Test Cell, and for military power runs in the Hush House, are shown in Figure 4-1.

Figure 4-1
Maximum 1-Hour Noise Exposure During Ground Run-up Operations



Ground crew hearing protection would be required during ground operations of the aircraft in accordance with AFOSH Standard 48-19. Under this regulation, workers are permitted a basic 8-hour noise level of 85 A-weighted dB, with exposure times halved for each 3 A-weighted dB increase in exposure, up to a maximum of 115 A-weighted dB for 30 seconds. Sound protection, including 25-dB ear defenders, would be required for all personnel working within 425 feet of the aircraft during pre-flight activity and within 1,700 feet of the Test Cell during military power runs.

Limiting exposure time for nonoccupational conditions is 90 A-weighted dB for 1 hour, or 85 A-weighted dB for an unlimited time. This level would be met at a distance of approximately 1,700 feet from an F-22 running at military power at the Test Cell. During pre-flight activities, the noise exposure could exceed 90 A-weighted dB within a 425-foot radius. The noise level of an aircraft changes by up to 10 dB around the plane, and exposures could be slightly less than those shown in Figure 4-3, depending upon the orientation of the aircraft during these activities. Levels and duration of exposure are expected to be similar to those of the F-15 activities that formerly occurred in these areas. The F-22 would be parked within 275 feet of Wolfe Avenue. When the aircraft leaves the area, the projected sound levels close to Wolfe Avenue would be diminished because of the 20-foot-high slope between the tarmac and Wolfe Avenue. Noise from initial taxiing activity of the F-22 may also affect pedestrians, bicyclists, and occupants

of open vehicles on Wolfe Avenue and in the Forbes Avenue parking area but would not be hazardous. These areas are close to parked aircraft and existing blast fencing. The slope deflects sound waves upwards and reduces other sound waves aimed directly at the road but would not reduce noise levels to below nonoccupational exposure levels. However, these noise levels from aircraft start-up and initial taxiing should not exceed the limiting exposure time of 1 hour. In addition, pedestrians, bicyclists, and vehicle occupants would be transiting the area and would not likely remain within the area exposed to these noise levels for the duration of the event.

Areas should be posted with warning signs concerning the potential of exposure to high levels of noise when aircraft are taxiing.

Airspace Complex Noise. The discussion addresses noise impacts from subsonic and supersonic operations in the R-2508 Complex and HASC.

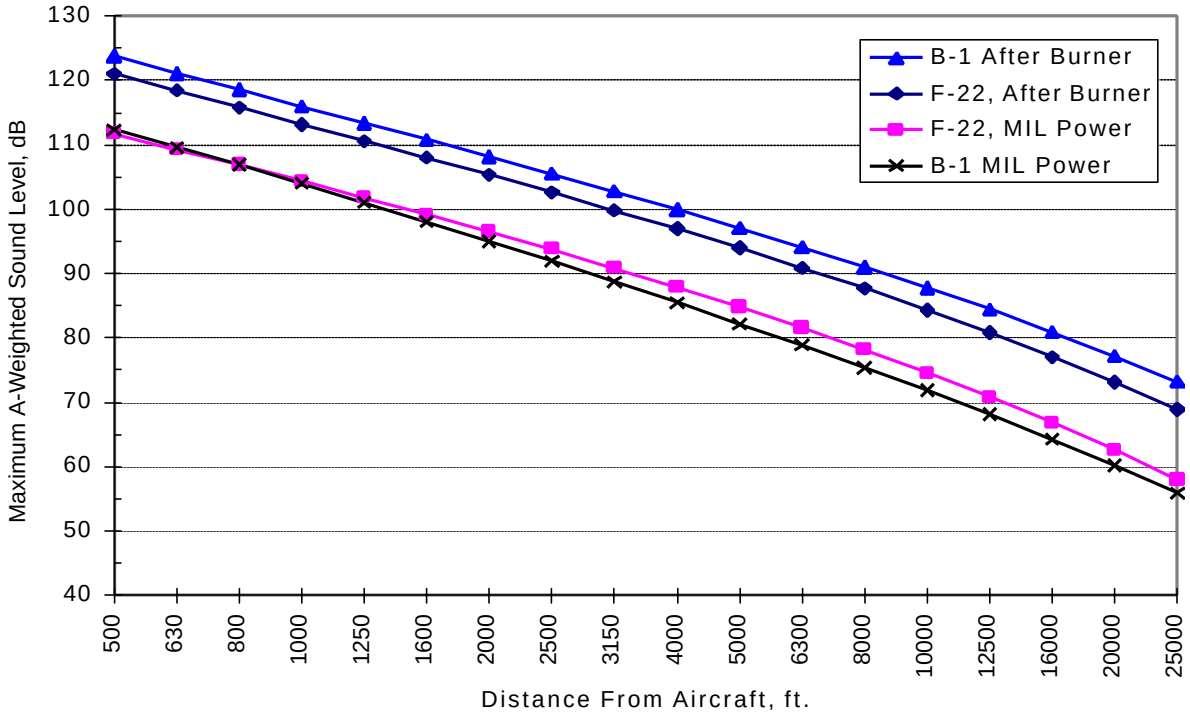
Subsonic Operations. The Proposed Action would result in an additional 206 F-22 sorties, an increase in range sorties of less than 0.4 percent. The noise levels produced by the F-22 are similar to those of the F-15C, and no significant increase in subsonic noise is expected.

The F-22 would be flown at altitudes above 3,000 feet AGL. Researchers suggest that exposure to intermittent noise levels of 90 A-weighted dB or less is not harmful to animals (Bowles et al., 1991). Maximum noise levels at the ground would be below 90 dBA for subsonic F-22 flights above 3,200 feet AGL for military power and for F-22 flights above 6,300 feet AGL for afterburner power (see Figure 4-1). Noise levels from subsonic flights above these heights would be less (see Figure 4-2). Figure 4-2 presents a comparison of the sound generated by the F-22 at various distances for MIL power and afterburner settings versus the F-18 and B-1. A comparison of the F-22 versus the F-15C would appear as a single line for each power setting since the F-22 noise model used was based on the F-15C.

Noise from subsonic aircraft flight would be generated within the airflight testing airspaces previously described. Subsonic aircraft flights routinely occur within these areas, and F-22 testing would conform to existing airspace restrictions, as discussed in Section 3.2. Environmental impact assessments for use of these areas have been conducted, and impacts were not shown to be significant (U.S. Air Force, 1991). The sound pressure levels from F-22 aircraft at military and afterburner power (based on F-15C modeling results) are compared to the maximum sound pressure levels from the B1-B in Figure 4-2. The figure illustrates that the sound pressure levels of both aircraft are similar at MIL power and that the F-22 afterburner sound pressure levels are quieter than the B1-B. Sound-related impacts from 1,000 hours of Dem/Val testing of the B1-B at Edwards AFB have not been found to be significant (U.S. Air Force, 1991). The proposed F-22 IOT&E flight activity is expected to total 403 hours. The noise- related impacts of the F-22 testing are, therefore, not assumed to be significantly different than those from B1-B Dem/Val testing. Furthermore, the number of F-22 flight hours per year would be a small fraction of the total flights within the R-2508 Complex.

1

Figure 4-2 Maximum Sound Level Under Centerline



Additionally, R-2515 EA concluded that an additional 2,216 annual subsonic operations of F-22 and F-16 aircraft associated with a new aircraft flight test program occurring within Restricted Area R-2515 would not create any adverse noise impacts (Air Force Flight Test Center, 1998). F-22 IOT&E would only entail 1,470 F-22 operations and 88 F-16 operations within Edwards AFB airspace. Because these would occur throughout the R-2508 Complex and HASC, and not be concentrated within a single restricted area (e.g., R-1515) within the complex, noise impacts from F-22 IOT&E activities would also not be expected to be significant.

Supersonic Operations. Supersonic operations have been conducted in these areas for more than 20 years. The direction of supersonic flight is rigidly controlled to minimize sonic boom impacts to communities near the corridors. These mitigation measures for noise impacts are standard procedure. The areas established for conduct of supersonic operations below 30,000 feet AGL overlie remote and desolate desert terrain. The population immediately below these corridors is extremely low in density. Above 30,000 feet AGL, the HASC overlies desert terrain. Outside of restricted airspace, the largest community beneath the HASC is Baker, California, with a population of 580. Within restricted airspace and above 30,000 feet, the portion of the existing supersonic corridors most utilized overlies the communities of Boron, North Edwards, Mojave, and Rosamond. Edwards AFB and Fort Irwin National Training Center are under this

part of the HASC. Since the F-22 has the capability of achieving supersonic speeds without using afterburners, there is the possibility that, during subsonic pilot training activities, an accidental supersonic excursion may occur. However, the resulting sonic booms cannot be quantified.

Between 1990 and 1994, an average of approximately 400 supersonic flights occurred annually in AFFTC supersonic corridors, although in 1996, over 1,000 supersonic flights occurred (Air Force Flight Test Center, 1998). Environmental impacts from aircraft noise within the AFFTC ranges have not been found to be significant (U.S. Air Force, 1991).

During F-22 supersonic test missions, one to three separate sonic booms are expected per supersonic flight test. During the 3-month pilot training period, 144 F-22 sorties are expected to include supersonic flights within the Black Mountain Supersonic Corridor and the HASC, and other areas as allowed. A maximum of 432 sonic booms could occur, increasing the sonic boom rate by over 3.5 times the existing rate. The intensity of the sonic boom overpressure at ground level is largely dependent upon the altitude and airspeed of an aircraft in straight and level flight. Based upon F-15 size and weight, the estimated maximum overpressures for the F-22 aircraft are shown in Figure 4-3 for a range of speeds and heights above the ground. As with any aircraft maneuvering or accelerating at supersonic speeds, a focus boom can be created that intensifies the boom by a factor of 2 to 5 over a small area.

The noise levels from supersonic flights of the F-22 are comparable to those of the F-15C and would be within the current range of noise levels in the R-2508 Complex and HASC.

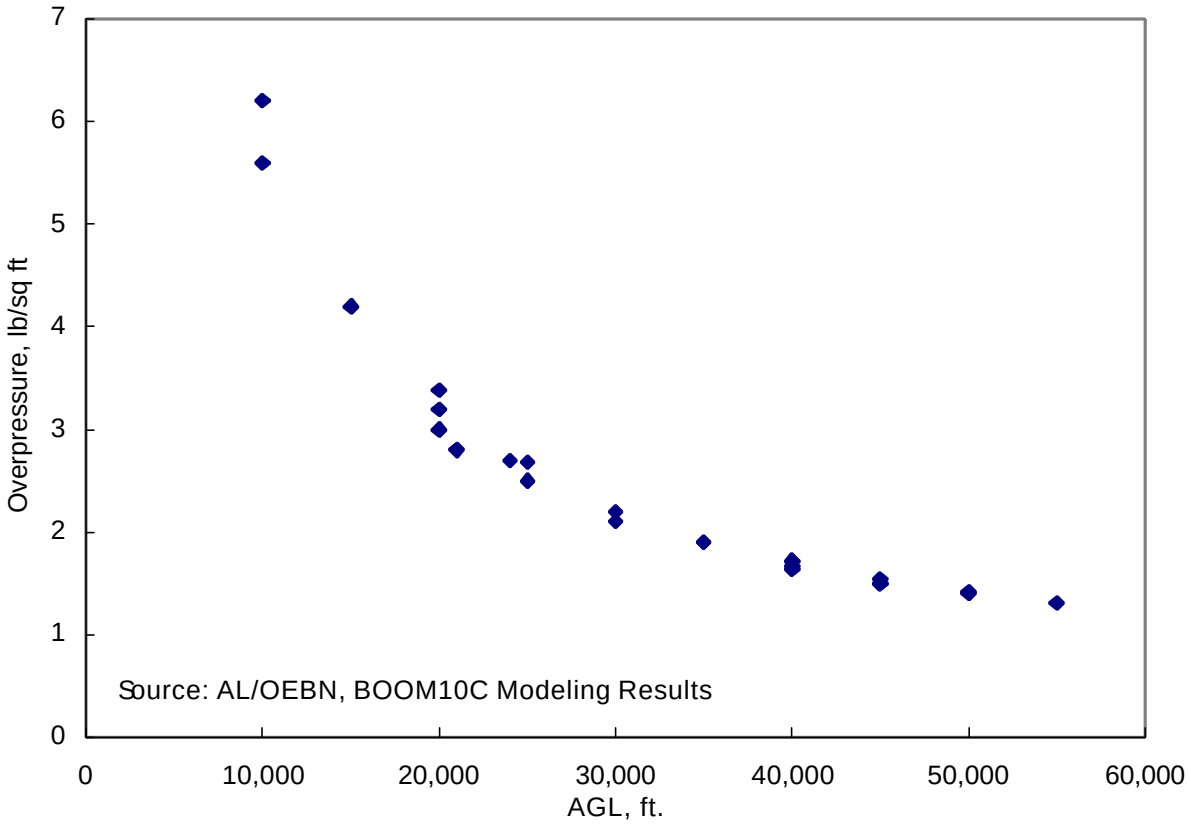
4.4.2.2 Nellis Range Complex.

Flight activity associated with the IOT&E operations would result in a less than 1-dB increase in noise within the NRC. Supersonic events would occur at least once during each flight test and could occur several times. Supersonic flights would occur only in authorized areas within the NRC. Under the Proposed Action, supersonic flights would continue in the same manner as they are presently conducted.

Sonic booms are not heard in all areas from an event. The estimated number of booms per month generated by F-22 IOT&E program could range from 0.02 booms per month for an area that's not often used for supersonic operations like the R74 sub-division to 1.89 booms per month for an area that's frequently used for supersonic operations like the Elgin sub-division. At the center of the Elgin subdivision, booms may be heard on an average of about one and a half sonic booms per day. In other parts of the NRC with supersonic flight activity, booms may be heard at an average of once every two weeks. The cumulative sonic boom exposure in the center of the Elgin subdivision of the Desert MOA would have CDNL in the range of 55 to 60 dB. CDNL elsewhere would be below

50 dB (U.S. Air Force, 1994a). The threshold of significant annoyance from sonic booms occurs at a CDNL value of 61 dB (National Academy of Sciences, 1981).

Figure 4-3
Estimated Sonic Boom
F-22 Flying Steady State at 1.1 to 1.4 Mach



The F-22 sorties would increase the number of sonic boom events per month if other sonic boom events remain at the current activity level. With one to three sonic boom events per flight test, the F-22 test flights would equate to a 0.05 to 4.41 percent increase over existing conditions. Depending upon the magnitude of the sonic booms (a function of Mach Number, altitude, and maneuver), the distribution of the events over the NRC, and the amount of time flying at supersonic speeds during each event, the CDNL could increase by over 2 dB. This exposure should remain below the level of significant annoyance within the NRC. Non-focused booms are not expected to exceed approximately 10 psf.

Observance of existing range restrictions regarding areas where supersonic flights are prohibited, avoidance of sensitive receptors, and minimum altitudes for supersonic operations would serve to minimize the frequency and intensity of sonic booms to which people may be exposed. Observance of existing minimum

flight altitudes would generally result in sonic booms with overpressures within the range of those routinely generated on the NRC.

4.4.3 Biological Resources

The Proposed Action could affect biological resources through generation of aircraft noise or sonic booms, visual exposure to aircraft overflight, or through animal/aircraft collision.

4.4.3.1 Edwards Air Force Base.

Vegetation. F-22 aircraft activities would not affect any plant species. Therefore, the Proposed Action is not expected to result in any impacts to vegetation.

Wildlife. The greatest effects of overflight on animals are from the visual effect of flying aircraft and the sound of its approach. No major visual impact is expected from the F-22 overflight, because operations would take place at altitudes above 3,000 feet AGL, well above the 550-foot AGL zone that has been shown to account for most wildlife reaction to visual stimuli (Bowles et al., 1991; Lamp, 1987).

Noise effects to wildlife are classified as primary, secondary, and tertiary. Primary effects are direct, physiological changes to the auditory system, (i.e., ear drum rupture, temporary and permanent hearing threshold shifts, and the masking of auditory signals). Secondary effects include nonauditory effects such as stress and associated physiological response (i.e., increased blood pressure, use of available glucose, blood corticosteroid levels); behavior modifications; interference with mating or reproduction; and impaired ability to obtain adequate food, cover, or water. Tertiary effects are the direct result of primary and secondary effects and include population declines, habitat loss, and species extinction.

The Proposed Action would increase aircraft activity in overflight areas over existing use of the area. However, this would represent only a 1-percent increase in airspace usage, and the noise level impact is not expected to be significant. Wildlife is expected to habituate to the slight increase in frequency and noise levels (U.S. Forest Service, 1992). Overflight would generally not occur at levels that could have startle effects on wildlife.

Noise effects have been examined for different taxonomic groups of wildlife. The results of these studies have been summarized in a U.S. Forest Service report to Congress (1992), pursuant to Section 5, Public Law 100-91, National Park Overflights Act of 1991. The effects of overflight noise on invertebrates, fish, reptiles, and amphibians have not been well studied, but conclusions about their expected responses have been speculated based upon the known physiology and behavior for these taxa. Invertebrates generally lack acute hearing apparatus and are not expected to respond to aircraft noise. Since noise is readily and well attenuated by water surfaces, aircraft noise is not expected to affect fish. Most reptiles do not exhibit a well developed acoustic startle response and are not expected to be affected by noise from overflights. Reptiles and amphibians that

respond to low frequencies, such as some desert lizards (*Gambelia*), and those that respond to ground vibration, such as toads (*Scaphiopus*), may be affected by noise.

Many researchers (Bowles et al., 1992; Calef et al., 1976; Ellis et al., 1991; Gladwin, 1978; Klein, 1973; Stewart, 1996; Pritchett et al., 1978) have studied the effects of aircraft noise on birds and mammals. Some of these studies have examined the noise responses of birds (e.g., Book and Bradley, n.d.) and mammals (e.g., Weisenberger et al., 1996) under laboratory conditions. Other researchers (Ellis et al., 1991, and Henson and Grant, 1991[for birds]; Lamp, 1987 [for mammals]) have investigated the physiological and behavioral responses of wildlife in the field. The primary criticism of laboratory studies is that the results invariably show habituation to continuous noise exposure. Both field and laboratory data, however, tend to indicate that wildlife appear to habituate to noise through exposure and appropriate behavioral or physiological modification without discernible long-term negative effects. Consequently, changes to the number and types of overflight are not expected to result in significant impacts to wildlife and wildlife populations.

Collisions between aircraft and birds occur infrequently; collisions with bats occur even less frequently. Strikes usually involve gregarious birds and usually occur during take-off or landing. Although larger soaring birds and some migratory birds can reach maximum altitudes of 10,000 feet AGL, the typical altitude for migrating waterfowl and other large gregarious birds is about 5,000 feet AGL. Generally, these flocks are avoidable by either direct observation or through the routine precautionary safety measures taken during flight planning. Edwards AFB cooperates with Kirtland AFB in maintaining bird-air strike hazard and Bird Avoidance Model evaluations of the flights flown by aircrews to minimize the risk of bird aircraft strikes. Special care is given during flight planning to avoid local sensitive areas and special care warnings regarding periods of bird migration. The bird-air strike hazard and Bird Avoidance Model consider the severity of the bird-air strike hazard at a particular time of day, month, and segment of a low-level route. Bats are generally nocturnal and fly at low altitudes, alone, or in small congregations, and are very rarely struck by aircraft.

Threatened and Endangered Wildlife. The Proposed Action may affect species protected under the federal ESA, the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act. Only wildlife is addressed in this section because impacts to vegetation, plants, and sensitive plants are not expected as result of project implementation.

The Proposed Action will require compliance with the federal ESA of 1973 (16 U.S.C. Sections 1531-1547 et al.). Section 7 of the ESA requires all federal agencies proposing actions with endangered species concerns to conduct an endangered species consultation prior to an irreversible and irretrievable commitment of resources. Formal consultation under Section 7 of the ESA is required when a federal agency determines that there may be a potential impact to individuals, populations, or habitat of a species listed under the ESA. Formal

consultation is a process between the USFWS and the proponent federal agency that concludes with the USFWS's issuance of an opinion stating whether or not the action is likely to jeopardize the continued existence of a listed species. There are 22 federally listed as threatened or endangered animal species in the Edwards AFB ROI (see Table 3-16). In addition to threatened and endangered species, the Proposed Action may affect species protected under the Migratory Bird Treaty Act (16 U.S.C. Sections 703-712) and the Bald and Golden Eagle Protection Act (16 U.S.C. Sections 668-668d).

As with other wildlife, the greatest effects of aircraft overflight on threatened and endangered species are from the visual effect of flying aircraft and the sound of its approach. No major visual impact is expected from the F-22 overflight because most operations would take place at altitudes well above the 550-foot AGL zone that has been shown to account for most wildlife reaction to visual stimuli (Bowles et al., 1991; Lamp, 1987).

The impacts of noise from overflight operations on wildlife have been discussed in the Wildlife section and are expected to be the same for threatened and endangered species. Fleischner and Weisberg (1986) have shown that bald eagles are susceptible to being startled by loud noises during the breeding season. Most bald eagles winter in the ROI, and potential breeding areas are situated at higher elevations and within national parks, wildlife refuges, and U.S. Forest Service areas where overflight is restricted by AFI 11-206 and Federal Aviation Regulations.

Other impacts of the Proposed Action could occur from bird/aircraft collisions. Studies have shown that these collisions are statistically rare events. The scarcity of threatened and endangered bird species and the precautionary measures employed in flight planning to reduce the risk of bird-air strike hazard further decrease the possibility that a listed bird or bird protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act would be affected. Continued implementation of impact avoidance measures is expected to minimize the potential impacts to populations of protected bird species.

Sensitive Habitats. Sensitive habitats for wildlife and birds, such as calving areas for mammals or major nesting and roosting areas for birds, are not expected to be affected by overflights. Data by Lamp (1987) show that startle effects that result in discernible modifications to wildlife physiology and behavior occur when overflights occur below 500 feet AGL. F-22 aircraft would not fly below 3,000 feet AGL during IOT&E.

4.4.3.2 Nellis Range Complex.

Vegetation. The use of flares, although remotely possible, may result in accidental fire. However, flares are designed to burn intensely and rapidly to simulate aircraft engines, and normally burn out well before reaching ground level. Furthermore, the use of flares is controlled within the ROI to minimize potential

fires and other hazards. Under the Proposed Action, flare usage would not change significantly from existing flare usage on the NRC.

Wildlife. As described for the Edwards AFB ROI, the greatest effects of overflight on animals are from the visual effect of flying aircraft and the sound of its approach. Impacts would be the same as those described under the Wildlife section of the Edwards ROI.

Threatened and Endangered Wildlife. Impacts from implementation of the Proposed Action on the NRC ROI would affect species protected under the federal ESA, the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act. There are 12 federally listed as threatened or endangered animal species in the NRC (see Table 3-17). The effects to threatened and endangered wildlife in the NRC ROI would be similar to those described for the Edwards AFB ROI. The regulatory requirements for compliance with federal laws that protect these species would be the same as those described for the Edwards AFB ROI.

Sensitive Habitats. The impacts to sensitive habitats in the NRC ROI would be similar to those expected for Edwards AFB. The NRC ROI encompasses about 3,500 acres of NWRs and wildlife resource areas. Nellis AFB also maintains cooperative agreements and Memoranda of Understanding with various federal and state agencies to ensure that wildlife habitat area management issues are addressed. The DNWR, the Pahranagat NWR, and the Key Pittman WMA are designated on the Nellis AFB Range Chart as noise-sensitive areas with special overflight restrictions. Aircraft are requested to fly at a minimum of 2,000 feet AGL over these areas. F-22 aircraft would remain above 3,000 feet AGL during IOT&E activities and therefore would remain above minimum overflight altitudes for these sensitive wildlife areas.

4.4.4 Cultural Resources

An undertaking is considered to have an effect on a historic property when the undertaking may alter characteristics of the property that may qualify the property for inclusion in the National Register. An effect is considered adverse when it diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Adverse effects on historic properties include, but are not limited to:

(1) Physical destruction, damage, or alteration of all or part of the property

(2) Isolation of the property from or alteration of the character of the property's setting when that character contributes to the property's qualification for the National Register

(3) Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting

(4) Neglect of a property resulting in its deterioration or destruction

(5) Transfer, lease, or sale of the property (36 CFR Part 800.9[b]).

The Proposed Action would have the potential to adversely affect cultural resources due to the vibrations from noise associated with supersonic and subsonic F-22 aircraft overflight. A discussion of the ways in which noise could affect cultural resources is provided hereafter.

4.4.4.1 Edwards Air Force Base.

Prehistoric Resources and Historic Resources and Structures. Public Law 100-91, passed in August 1987, directed the U.S. Forest Service and the National Park Service to conduct studies and make recommendations to Congress on aircraft overflights that may affect either the visitors or the resources of the national forest system and national parks. Completed in July 1992, this cooperative study concluded the following:

- Because many cultural resources are situated in remote and uninhabited areas, documented observations of aircraft noise effects are rare.

- Most of the available literature relates to research by the Air Force, NASA, and the FAA, and has focused on the effects of sonic booms.

- A recently developed prediction method places a definite risk of damage to prehistoric structures (e.g., rock art, rock alignments, rock cairns) from low overflights of heavy bombers and helicopters. However, measurement programs have been conducted that conclude that there is minimal risk of damage to structures from light, low-flying subsonic jet aircraft and light helicopters.

- Some evidence exists that long-term effects of noise exposure could result in damage by initiating or accelerating the deterioration process, especially to already fragile resources. Long-term effects appear as (1) fatigue effects in walls and other structural elements after extensive exposure, (2) moisture damage initiated by cosmetic cracks in exterior surfaces, and (3) gradual erosion of surface materials (e.g., adobe mud-plastered walls) from repeated events (U.S. Department of Agriculture, 1992).

Several other studies have addressed this subject as well, including analysis of a similar proposed action involving F-15 and F-16 aircraft at Mountain Home AFB, Idaho (U.S. Air Force, 1992b). That study concluded that for subsonic flights to cause structural damage to a building, the structure would have to be within 150 feet of an aircraft generating noise at DNL 120 dB. F-22 aircraft would remain above 3,000 feet AGL, and noise levels from the F-22 at this altitude would be below 95 A-weighted dB during military power, and approximately 100 A-weighted dB during afterburner use (see Figure 4-1). Another study (Battis,

1988), which examined the effects of overflight-induced vibration on Long House, a 1,000-year-old Arizona adobe, concluded that the probability for damage is very low (less than 0.3 percent). Additional studies by Goforth and McDonald (1968) and Battis (1981) suggest that 5-psf or less overpressures are within the limits considered safe for historic structures. Because studies involving F-15, F-16, and F-18 aircraft overpressures resulted in only 18 of 609 recorded overpressures in excess of 5 psf, the likelihood of significant impacts to historic properties from these types of aircraft (including the F-22) remains low. Moreover, the likelihood of damage decreases with distance from the centerline of the flight path, thereby reducing the likelihood of vibration-induced effects such as rockfall (e.g., rock alignments, cairns) (U.S. Air Force, 1992b). The California SHPO has concurred that the supersonic low-altitude flights that have occurred within the Black Mountain Supersonic Corridor for more than 25 years have resulted in insignificant impacts to cultural resources (U.S. Air Force, 1995b).

Based upon the above-described studies and results, noise and vibration from overflights as a result of the Proposed Action are not expected to cause significant impacts to historic properties.

Consultation with the California SHPO, in accordance with the regulations for the Protection of Historic Properties (36 CFR Part 800) that implement Section 106 of the NHPA, will be conducted for the Proposed Action.

Native American (Traditional) Resources. As with prehistoric and historic archaeological sites and historic structures, sites of traditional cultural value or religious significance to Native Americans that qualify for inclusion in the National Register are afforded the protection of Section 106 of the NHPA. For such cultural resources, the adverse condition most often cited relates to the introduction of visual, audible (e.g., noise intrusion into religious ceremonies), or atmospheric elements that are out of character or alter setting (36 CFR Part 800.9[b][3]).

Several sites known to be culturally important to Native American tribes are within the R-2508 Complex. These sites include, but are not limited to, Black Mountain/Inscription Canyon, Saline Valley, Horse Canyon, Jawbone/Butterhead Area, Greenwater Canyon, and Coso Hot Springs. However, because such resources are frequently underreported, and because the review of site records indicates that some of the identified archaeological sites contain components considered to have religious and traditional cultural value to Native Americans, consultations will be conducted to ensure that Native American concerns are identified and adequately considered under the Proposed Action. These groups include the Cahuilla, Chumash, Foothill Yokuts, Gabrieleno, Kawaiisu, Kitanemuk, Koso, Luiseno, Monache, Northern Paiute Kawaiisu, Owens Valley Paiute, Panamint Shoshone, Serrano, Southern Paiute and Chemehuevi, Southern Valley Yokuts, Tataviam, Tongua, Tubatulabal, Vanyume, Yokut, and Yowlumne.

4.4.4.2 Nellis Range Complex

Prehistoric Resources and Historic Resources and Structures. Based upon the above-described studies and results discussed under Edwards AFB, noise and vibration from overflights as a result of the Proposed Action are not expected to cause significant impacts to historic properties in the NRC.

Consultation with the Nevada SHPO, in accordance with the regulations for the Protection of Historic Properties (36 CFR Part 800) that implement Section 106 of the NHPA, will be conducted for the Proposed Action.

Native American (Traditional) Resources. Currently, no National Register-eligible or -listed Native American resources are known to exist within the Nellis AFB APE, and therefore, no significant impacts would be expected to occur. However, because such resources are frequently underreported, and because the review of site records indicates that some of the identified archaeological sites contain components considered to have religious and traditional cultural value to Native Americans, consultations with the Paiutes, Shoshone, Colorado River, Chemehuevi, Fort Mojave, and Las Vegas Indian Center have been initiated to ensure that their concerns are identified and adequately considered under the Proposed Action.

4.5 EVALUATION OF THE NO-ACTION ALTERNATIVE

Under the No-Action Alternative, no F-22 IOT&E phase activities would occur. No IOT&E flight testing aircraft would occur in the Edwards AFB and NRC airspace, and no associated ground support activities would occur at Edwards AFB. Current programs would continue at Edwards AFB, the R-2508 Complex, the HASC, and the NRC.

Overall, the No-Action Alternative would have negligible environmental effects. No impacts to land use or changes in airspace usage would occur. Usage of hazardous materials and generation of hazardous waste associated with the F-22 would not occur. No project-related air emissions or noise would be generated, and no impacts to biological and cultural resources would occur.

4.6 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

There would be no unavoidable adverse environmental effects from implementation of the F-22 IOT&E-phase activities.

4.7 COMPATIBILITY OF THE PROPOSED ACTION WITH OBJECTIVES OF FEDERAL, REGIONAL, STATE, AND LOCAL LAND USE PLANS AND POLICIES

The Proposed Action does not entail any activity that would result in a change in land use. No significant impacts to existing land uses from aircraft overflight noise levels and sonic booms would occur, provided suitable mitigation measures listed in this EA are incorporated.

4.8 RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

The Proposed Action would not affect the long-term productivity of the environment, because no significant adverse environmental impacts are anticipated.

4.9 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Irreversible and irretrievable commitment of resources would occur in the form of jet fuel and other petroleum products that would be consumed during use.

4.10 CUMULATIVE ENVIRONMENTAL CONSEQUENCES

Cumulative impacts result from the "incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over periods of time" (Council on Environmental Quality, 1978).

A review of reasonably foreseeable future actions presenting a potential for generating cumulative impacts in association with F-22 IOT&E activities was conducted. The analysis covered programs and activities that are currently scheduled, that are not accounted for in the baseline conditions as described in Section 3.0 of this EA, and projected funded programs or activities. This review indicated that the Joint Strike Fighter Concept Development program should not create any cumulative impacts with F-22 IOT&E activities. The Joint Strike Fighter activities are scheduled between September 2000 and October 2001. The main impacts of that program would be to noise and air quality and would be limited to the duration of the activities (Air Force Flight Test Center, 2000). Because F-22 IOT&E activities would not commence until March 2002, cumulative impacts from the two programs would not be expected. NASA's Dryden Flight Research Center has 9 programs currently in progress which are 1)Apex, 2) Environmental Research And Sensor Technology Program (ERAST), 3) F-15B Research Testbed, 4) F-18 System Research Aircraft (SRA), 5) Revolutionary Concepts in Aeronautics (RevCon), 6) X-38 Crew Return Vehicle (CRV), 7) X-38 Actuator Control Test Project (XACT), 8) the X-43A/Hyper-X, and 9) ER-2 AVIRIS. The environmental effects of these programs were included in the baselines used in this analysis. Of these programs APEX, X-38 CRV, X-38 XACT, and X-43 should be completed by early 2002. The Dryden Flight Research Center also indicated that while there may be other programs under consideration to occur during the F-22 IOT&E time frame none have been funded. An evaluation of the environmental effects of the NASA Dryden programs indicates that they do not represent a significant cumulative impact when considered with the F-22 IOT&E program.

Activities associated with the F-22 Force Development Evaluation and Weapons School Beddown at Nellis AFB and various exercises conceptually similar to Red Flag could overlap with F-22 IOT&E activities within the NRC. Aircraft operations from this project are accounted for in the 200,000 to 300,000 sortie operations

baseline scenario for the NRC that is used in the analysis in this EA. Therefore, the cumulative effects are encompassed within the analyses in Chapter 4.0.

No other activities that could contribute to cumulative impacts with F-22 IOT&E activities in the NRC were identified; therefore, no cumulative environmental impacts in the NRC have been identified.

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5.0 CONSULTATION AND COORDINATION

FEDERAL AGENCIES

U.S. Air Force, Edwards AFB
U.S. Air Force, Nellis AFB
USFWS, Reno Field Office
USFWS, Salt Lake City Field Office
USFWS, Ventura Field Office

STATE AGENCIES

California Natural Heritage Program, Department of Fish and Game
California State Historic Preservation Officer
Nevada Division of Environmental Protection, Bureau of Air Quality
Nevada Natural Heritage Program, Department of Conservation and Natural Resources
Nevada State Historic Preservation Officer
Utah Natural Heritage Program, Division of Wildlife Resources
Utah State Historic Preservation Officer

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7.0 DISTRIBUTION

Federal Agencies

Bureau of Land Management, Barstow Area Office
Bureau of Land Management, Ridgecrest Field Office
Death Valley National Park
Edwards Air Force Base
Federal Aviation Administration, Western Pacific Region
Fort Irwin National Training Center
Nellis Air Force Base
Kirtland Air Force Base
Naval Air Weapons Center, China Lake
U.S. Environmental Protection Agency, Region IX
U.S. Fish and Wildlife Service, Ventura Field Office

State Agencies

California State Clearinghouse
Nevada State Clearinghouse
Mojave Desert Air Quality Management District

Libraries

Kern County Library, Boron Branch
Kern County Library, Wands Kirk Branch, Rosamond
Los Angeles County Library, Lancaster Branch

Other Organizations

Native American Heritage Commission

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8.0 REFERENCES

412 TW/TSRO, 1995. Range Capabilities Handbook (Draft), Edwards Air Force Base, California, June.

Air Combat Command, 1998. Nellis Air Force Base Cultural Resources Management Plan, August.

Air Force Flight Test Center, 1995. Air Force Flight Test Center Summary, Cost and Business Strategies Division, Edwards Air Force Base, 31 March.

Air Force Flight Test Center, 1997. Preliminary Draft Integrated Natural Resources Management Plan, prepared for U.S. Army Engineer District, Sacramento, Corps of Engineers and Air Force Flight Test Center, Environmental Management Directorate, prepared by Earth Tech. January.

Air Force Flight Test Center, 1998. Environmental Assessment for the Continued Use of Restricted Area R-2515, Edwards Air Force Base, California, April.

Air Force Flight Test Center, 2000. Environmental Assessment for the Concept Demonstration Phase of the Joint Strike Fighter at Edwards Air Force Base, California, September.

Air Resources Board, 1996. *Maps and Tables of the Area Designations for State and National Ambient Air Quality Standards, and Expected Peak Day Concentrations and Designation Values*. Technical Support Division.

Battis, J.C., 1981. Seismo-Acoustical Effects of Sonic Booms on Archaeological Sites, Valentine Military Operations Area. AFGL Technical Memorandum No. 50.

Battis, J.C., 1988. Effects of Low-Flying Aircraft on Archaeological Structures, January 26.

Book, C.M. and F.A. Bradley, n.d. Behavioral effects of simulated F-4D aircraft overflights on Nicholas turkey poults. Abstract of paper; source unknown.

Bowles, A., B. Tabachnick, and S. Fidell, 1991. Review of the effects of aircraft overflights on wildlife. National Park Service, Denver, Colorado.

Calef, G.W., E.A. DeBock, and G.M. Lortie, 1976. The reaction of barren ground caribou to aircraft, Arctic 29(4):201-212

California Department of Fish and Game, 2001. California Natural Diversity Database Special Animals, January.

California Environmental Protection Agency, Air Resources Board, 1997. Proposed Amendments to Area Designations for State Ambient Air Quality Standards and Proposed Maps of the Area Designations for the State and National Ambient Air Quality Standards, Staff Report, Sacramento, California, 13 November.

California Office of Planning and Research, 1987. General Plan Guidelines.

City of Lancaster, 1994. Edwards Air Force Base Joint Land Use Study.

Clark County Board of Commissioners, 1995. *CO Air Quality Implementation Plan for the Las Vegas Valley Nonattainment Area, Clark County, Nevada.*

Clark County Board of Commissioners, 1997. *Draft PM (PM_{10}) Air Quality Implementation Plan for the Las Vegas Valley Nonattainment Area, Clark County, Nevada*.

Council on Environmental Quality, 1998. Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act.

Edwards Air Force Base, 1994. Comprehensive Plan, June.

Edwards Air Force Base, 1995. Hazardous Waste Management Plan, Number 32-7042, September.

Edwards Air Force Base, 1996. Pollution Prevention Plan, December.

Ellis, D.H., C.H. Ellis, and D.P. Mindell, 1991. Raptor responses to low-level jet aircraft and sonic booms. Environmental Pollution 74(1991) 53-83.

Environmental Laboratory, 1987. Corps of Engineers Wetland Delineation Manual, Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Fleischner, T.L., and S. Weisberg, 1986. Effects of jet aircraft activity on bald eagles in the vicinity of Bellingham International Airport, Unpublished Report, DEVCO Aviation Consultants, Bellingham, Washington.

Gladwin, D.N., 1978. A*E*I*S: an airport environmental information system for Virginia. M.S. Thesis, Virginia Polytechnical Institute and State University, Blacksburg.

Goforth, T.T., and J.A. McDonald, 1968. "Seismic Effects on Sonic Booms," NASA CR-1137. Cited in Assessing Noise Impacts of Air Force Flying Operations, Headquarters USAF/LEEV, May.

Hensen, P. and T.A. Grant, 1991. The effects of human disturbance on trumpeter swan breeding behavior. Wildlife Society Bulletin 19: 248-257.

Hershey, R., and T. Higgins, 1973. Statistical Prediction Model for Glass Breakage from Nominal Sonic Boom Loads, prepared for the Department of Transportation and Federal Aviation Administration, January.

Jagielski, K.D., and R.J. O'Brien, 1994. *Calculation Methods for Criteria Air Pollutant Emission Inventories*, Occupational and Environmental Health Directorate, Bioenvironmental Engineering Division, Brooks Air Force Base, Texas.

Kern County Air Pollution Control District, 1993a. 1990 Base Year Inventory.

Kern County Air Pollution Control District, 1993b. *1993 Rate-of-Progress Plan*.

Kern County Air Pollution Control District, 1994a. *Reasonable Further Progress Plan*.

Kern County Air Pollution Control District, 1994b. *Attainment Demonstration Plan*.

Kern County Air Pollution Control District, 1996. 1994 Estimated Average Daily Emissions.

Klein, D.R., 1973. The reaction of some northern mammals to aircraft disturbance, in 11th International Congress Game Biologists, Sept. 3-7, 1973, Natl. Swedish Environmental Protection Board, Stockholm, Sweden.

Lamp, R.E., 1987. Monitoring the effects of military operations at NAS Fallon on the biota of Nevada. Job progress report for 1986-1987. Nevada Department of Wildlife.

National Academy of Sciences, 1977. Guidelines for Preparing Environmental Impact Statement on Noise. Report on Working Group Committee on Hearing, Bioacoustics and Biomechanics, Assembly of Behavioral and Sciences, National Research Council, Washington, DC.

National Academy of Sciences, 1981. The Effects on Human Health from Long-Term Exposure to Noise. Report of Working Group 81, Committee on Hearing, Bioacoustics and Biomechanics, Assembly of Behavioral and Social Sciences, National Research Council, Washington, DC.

National Geographic Society, 1982. America's Federal Lands, map supplement to National Geographic Magazine, Washington, DC, September.

National Oceanic and Atmospheric Administration, 1997a. Los Angeles Sectional Aeronautical Chart, 60th edition, January 27.

National Oceanic and Atmospheric Administration, 1997b. Las Vegas Sectional Aeronautical Chart, 57th edition, March 27.

National Oceanic and Atmospheric Administration, 1997c. International Station Meteorological Climate Summary, Edwards Air Force Base, California. Based on data recorded from March 1979 through February 1989.

Nellis Air Force Base, 1994. An Inventory for Rare, Threatened, Endangered, and Endemic Plants and Unique Communities of Nellis Air Force Bombing and Gunnery Range, Clark, Lincoln, and Nye Counties, Nevada. Volume I. In partnership with The Nature Conservancy, Legacy Resource Management Program Contract No. M67004-91-D-0010-S401, January.

Nellis Air Force Base, 1995. An Inventory for Rare, Threatened, Endangered, and Endemic Plants and Unique Communities on Nellis Air Force Bombing and Gunnery Range, Clark, Lincoln, and Nye Counties, Nevada. Volume II. In Partnership with Nellis Air Force Base, Nevada Natural Heritage Program, and the Nature Conservancy, January.

Nellis Air Force Base, 1996a. An Inventory for Rare, Threatened, Endangered, and Endemic Plants and Unique Communities on Nellis Air Force Bombing and Gunnery Range, Clark, Lincoln, and Nye Counties, Nevada. Volume III. In Partnership with Nellis Air Force Base, Nevada Natural Heritage Program, and the Nature Conservancy, January.

Nellis Air Force Base, 1996b. Nellis AFB Environmental Management Directorate. Prepared by Dames & Moore, Job No. 13474-085-001, September.

Nellis Air Force Base, 1996c. Summary of Bird Surveys, Nellis Air Force Range, January 1996 - June 1996, August.

Nellis Air Force Base, 1997. Integrated Natural Resources Management Plan, Nellis Air Force Base/Nellis Air Force Range (Draft), March.

Nevada Division of Environmental of Protection, 1997. Personal communications with Sheryl Bryant, Environmental Management Specialist.

Pritchett, J.F., M.L. Browder, R.S. Caldwell, and J.L. Sartin, 1978. Noise stress and in vitro adreno-cortical responsiveness in ACTH in wild cotton rats, Sigmodon hispidus. Environ. res. 16:29-37.

R-2508 Complex Control Board, 1997. R-2508 Complex User's Guide, published under authority of the R-2508 Joint Policy and Planning Board, 1 May.

Rand McNally and Company, 1996. Road Atlas.

Stewart, B.S., 1996. Assessment of potential impacts of launch noise and sonic boom from Titan IV/NUS Space Launch Vehicles on Pinnipeds near Vandenberg Air Force Base and on the Southern California Channel Islands. Hubbs-Sea World Research Institute Technical Report 96-262:1-143.

Steinhart, P., 1990. California's Wild Heritage, Threatened and Endangered Animals in the Golden State.

U.S. Air Force, 1984. Environmental Assessment Edwards AFB Supersonic Corridors, Air Force Flight Test Center, Edwards Air Force Base, California

U.S. Air Force, 1989. HSD-TR-89-001 Noise and Sonic Boom Technology.

U.S. Air Force, 1991. Advanced Tactical Fighter Full-Scale Development Environmental Assessment, April 22.

U.S. Air Force, 1992a. A Guidance Document for Air Installation Compatible Use Zone (AICUZ) Program.

U.S. Air Force, 1992b. Final Environmental Impact Statement Proposals for the Air Force in Idaho, January.

U.S. Air Force, 1994a. Environmental Assessment for Supersonic Flight Over the Nellis Range Complex, Nellis Air Force Base, Las Vegas, Nevada.

U.S. Air Force, 1994b. F-22 Combined Test Force Beddown Environmental Assessment Edwards Air Force Base, California, prepared for Air Force Flight Test Center, Environmental Management, Edwards Air Force Base, prepared by Computer Science Corporation, November.

U.S. Air Force, 1995. *Clean Air Act General Conformity Analysis, Edwards Air Force Base, California*, November.

U.S. Air Force, 1995b. Environmental Assessment for Continued Supersonic Operations in the Black Mountain Supersonic Corridor and the Alpha/Precision Impact Range Area, prepared for Air Force Flight Test Center, Environmental Management Office, Edwards Air Force Base, prepared by Computer Science Corporation, August.

U.S. Air Force, 1996. *U.S. Air Force Air Conformity Applicability Model, Version 2.0 LT*, Technical Documentation, April.

U.S. Air Force, 1997a. AFFTC SPR Plan 32-4002, AFFTC Oil and Hazardous Substance Spill Prevention and Response Plan, HQ AFFTC, Edwards Air Force Base, California, January 1.

U.S. Air Force, 1997b. *Edwards Air Force Base 1996 Criteria Pollutant Emissions Inventory Report.*

U.S. Air Force, 1997c. Programmatic Environmental Assessment for Routine Flightline Activities, Edwards Air Force Base, California, prepared for Air Force Flight Test Center, Environmental Management, Edwards Air Force Base, prepared by Computer Science Corporation, March.

U.S. Air Force, 1999. F-22 Aircraft Force Development Evaluation and Weapons School Permanent Beddown, Nellis Air Force Base Environmental Impact Statement October.

U.S. Air Force, 2000. Tyndall F-22 Beddown Environmental Impact Statement, June.

U.S. Air Force Air Combat Command, 1997. Environmental Effects of Self-Protection Chaff and Flares, August.

U.S. Army Corps of Engineers et al., 1997. R-2508 Complex Environmental Baseline Study, prepared for the U.S. Army Corps of Engineers, Sacramento District, and the Air Force Flight Test Center, Environmental Management Office, Edwards Air Force Base, California, prepared by GRW Engineers and Tetra Tech, Inc., August.

U.S. Bureau of Land Management, 1980. The California Desert Conservation Area Plan. U.S. Department of the Interior, BLM Desert District, Riverside, California.

U.S. Department of Agriculture, 1992. Potential Impacts of Aircraft Overflights of National Forest System Wilderness, July.

U.S. Department of Transportation, 1980. The Federal Interagency Committee on Urban Noise Developed Land Use Compatibility Guidelines for Noise.

U.S. Environmental Protection Agency, 1992. Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources, Office of Mobile Sources, Ann Arbor, Michigan, and Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. EPA-450/4-81-026d (Revised).

U.S. Fish and Wildlife Service, 2000. At: http://ecos.fws.gov/webpage/webpage_vip_listed.html?&code=V&listings=0.

U.S. Forest Service, 1992. Report to Congress: Potential Impacts of Aircraft Overflights of National Forest System Wildernesses. Report prepared pursuant to Section 5, Public Law 100-91, National Park Overflights Act of 1987. Washington DC.

Utah Division of Wildlife Resources, 1998. Utah Sensitive Species List, February.

Weisenberger, M.E., P.R. Krausman, M.C. Wallace, D.W. DeYoung, and O.E. Maughan, 1996. Effects of simulated jet aircraft noise on heart rate and behavior of desert ungulates. Journal Wildlife Management 60(1):52-61.

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APPENDIX A

GLOSSARY OF TERMS AND ACRONYMS/ABBREVIATIONS

APPENDIX A

GLOSSARY OF TERMS AND ACRONYMS/ABBREVIATIONS

GLOSSARY OF TERMS

Aircraft operation. A takeoff or landing at an airport.

Air Traffic Control Assigned Airspace (ATCAA). Airspace of defined vertical/lateral limits, assigned by Air Traffic Control (ATC), for the purpose of providing air traffic segregation between the specified activities being conducted within the assigned airspace and other Instrument Flight Rules (IFR) air traffic. (FAA, 1991b).

Ambient Air Quality Standards. Standards established on a state or federal level that define the limits for airborne concentrations of designated "criteria" pollutants (nitrogen dioxide [NO_2], sulfur dioxide [SO_2], carbon monoxide [CO], total suspended particulates, ozone, and lead), to protect public health with an adequate margin of safety (primary standards), and to protect public welfare including plant and animal life, visibility, and materials (secondary standards).

Attainment area. A region that meets the National Ambient Air Quality Standards (NAAQS) for a criteria pollutant under the Clean Air Act.

A-Weighted Sound Level (dBA). A number representing the sound level which is frequency weighted according to a prescribed frequency response established by the American National Standards Institute (ANSI S1.4-1971) and accounts for the response of the human ear.

Biological resources. The native and introduced plants and animals in the project area.

Carbon monoxide (CO). A colorless, odorless, poisonous gas produced by incomplete fossil-fuel combustion. One of the six pollutants for which there is a national ambient standard. See Criteria Pollutants.

Class I, II, and III Areas. Area classifications, defined by the Clean Air Act, for which there are established limits to the annual amount of air pollution increase. Class I areas include international parks and certain national parks and wilderness areas; allowable increases in air pollution are very limited. Air pollution increases in Class II areas are less limited, and are least limited in Class III areas. Areas not designated as Class I start out as Class II, and may be reclassified up or down by the state, subject to federal requirements.

Commercial aviation. Aircraft activity licensed by state or federal authority to transport passengers and/or cargo for hire on a scheduled or nonscheduled basis.

Comprehensive Plan. A public document, usually consisting of maps, text, and supporting materials, adopted and approved by a local government legislative body that describes future land uses, goals, and policies.

Council on Environmental Quality (CEQ). Established by the National Environmental Policy Act (NEPA), the CEQ consists of three members appointed by the President. CEQ regulations (40 Code of Federal Regulations Parts 1500-1508, as of July 1, 1986) described the process for implementing NEPA, including preparation of environmental assessments and environmental impact statements, and the timing and extent of public participation.

Criteria Pollutants. The Clean Air Act required the U.S. Environmental Protection Agency (EPA) to set air quality standards for common and widespread pollutants after preparing "criteria documents" summarizing scientific knowledge on their health effects. Currently, there are standards in effect for six "criteria pollutants": SO_2, CO, particulate matter equal to or less than 10 microns in diameter (PM_{10}), NO_2, ozone, and lead.

Cultural resources. Prehistoric and historic districts, sites, buildings, objects, or any other physical evidence of human activity considered important to a culture, subculture, or a community for scientific, traditional, religious, or any other reason.

Cumulative impacts. The combined impacts resulting from all activities occurring concurrently at a given location.

C-Weighted Day-Night Average Sound Level (CDNL). Similar to DNL, but uses C-weighted sound level rather than A-weighted, allowing low-frequency dominated noises emissions to be evaluated.

Day-night average sound level (DNL). The 24-hour average-energy sound level expressed in decibels (dB), with a 10-dB penalty added to sound levels between 10:00 p.m. and 7:00 a.m. to account for increased annoyance due to noise during night hours.

Decibel (dB). A unit of measurement on a logarithmic scale that describes the magnitude of a particular quantity of sound pressure or power with respect to a standard reference value.

Endangered species. A species that is threatened with extinction throughout all or a significant portion of its range.

Environmental Impact Analysis Process (EIAP). The process of conduction environmental studies, as outlined in Air Force Instruction 32-7061.

Equivalent Sound Level (L_{eq}). Total A-weighted sound energy averaged over a given period of time.

Habituate. To become accustomed to frequent repetition or prolonged exposure.

Hazardous materials/hazardous waste. Those substances defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act, as amended, and the Solid Waste Disposal Act, as amended, by the Resource Conservation and Recovery Act, as amended. Generally, this includes substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may present substantial danger to public health of welfare or the environment when released into the environment.

Historic Sites. Under the National Historic Preservation Act (NHPA), these are properties of national, state, or local significance in American history, architecture, archaeology, engineering, or culture, and worthy of preservation.

Impacts/effects. An assessment of the meaning of changes in all attributes being studied for a given resource; an aggregation of all the adverse effects, usually measured using a qualitative and nominally subjective technique. In this environmental assessment, as well as in the CEQ regulations, the word impact is used synonymously with the word effect.

Instrument Flight Rules (IFR). Rules governing the procedures for conducting instrument flight.

Lithic Scatters. An archaeological site consisting of dispersed stone artifacts and fragments.

Mach Number. The ratio of the speed of an object to the speed of sound in the surrounding medium.
Masking. The action of bringing one sound (audible when heard alone) to inaudibility or to unintelligibility by the introduction of another sound.

Maximum Sound Level. The highest sound level recorded during an event without regard for duration.

Mean sea level (MSL). The average height of the sea surface if undisturbed by waves, tides or winds.

Military Operations Area (MOA). Airspace area of defined vertical and lateral limits established for the purpose of separating certain training activities such as air combat maneuvers, air intercepts, and aerobatics from other air traffic operating under IFR.

Mitigation. A method or action to reduce or eliminate program impacts.

National Ambient Air Quality Standards (NAAQS). Section 109 of the Clean Air Act requires the U.S. EPA to set nationwide standards, the NAAQS, for widespread air pollutants. Currently six pollutants are regulated by primary and secondary NAAQS: CO, lead, NO_2, ozone, PM_{10}, and SO_2. See Criteria Pollutants.

National Environmental Policy Act (NEPA). Public Law 91-190, passed by Congress in 1969. The Act established a national policy designed to encourage consideration of the influences of human activities (e.g., population growth, high-density urbanization, industrial development) on the natural environment. NEPA also established the CEQ. NEPA procedures require that environmental information be made available to the public before decisions are made. Information contained in NEPA documents must focus on the relevant issues in order to facilitate the decision-making process.

National Register of Historic Places (National Register). The nation's master inventory of known historic properties worthy of preservation. The National Register is administered by the National Park Service on behalf of the Secretary of the Interior. National Register listings include buildings, structures, sites, objects, and districts that possess historic, architectural, engineering, archaeological, or culture significance. Properties listed are not limited to those of national significance; most are significant primarily at the state or local level.

Native Americans. Used in a collective sense to refer to individuals, bands, or tribes who trace their ancestry to indigenous populations of North America prior to Euro-American contact.

Native vegetation. Plant life that occurs naturally in an area without agricultural or cultivational efforts. It does not include species that have been introduced from other geographical areas and become naturalized.

Nautical mile. A unit of distance used for air navigation based on the length of a geographical minute of arc. It is equal to 6076.115 feet.

Nitrogen dioxide (NO_2). Gas formed primarily from atmospheric nitrogen and oxygen when combustion takes place at high temperatures. NO_2 emissions contribute to acid deposition and formation of atmosphere ozone. One of the six pollutants for which there is an NAAQS. See Criteria Pollutants.

Nitrogen oxides (NO_x). Gases formed primarily by fuel combustion, which contribute to the formation of acid rain. Hydrocarbons and NO_x combine in the presence of sunlight to form ozone, a major constituent of smog.

Noise. Any sound that is undesirable because it interferes with speech and hearing, is intense enough to damage hearing, or is otherwise annoying (unwanted sound).

Noise attenuation. The reduction of a noise level from a source by such means as distance, ground effects, or shielding.

Nonattainment area. An area that has been designated by the U.S. EPA or the appropriate state air quality agency, as exceeding one or more national or state ambient air quality standard.

Overpressure. The pressure, exceeding ambient pressure defined in pounds per square foot (psf), manifested in the shock wave of an explosion or sonic boom.

Ozone (ground level). A major ingredient of smog. Ozone is produced from reactions of hydrocarbons and NO_x in the presence of sunlight and heat. One of the six pollutants for which there is an NAAQS. See Criteria Pollutants.

Polyalphaolefin (PAO). An antifreeze/coolant used for F-22 aircraft avionics.

Prehistoric. The period of time before the written record.

Prevention of Significant Deterioration (PSD). In the 1977 Amendments to the Clean Air Act, Congress mandated that areas with air cleaner than required by national ambient air quality standards must be protected from significant deterioration. The Clean Air Act's PSD program consists of two elements required for best available control technology on major new of modified sources, and compliance with an air quality increment system.

RAPCON. Radar Approach Control. A U.S. Air Force facility providing approach control service by means of acquisition Surveillance Radar (ASR) and Precision Approach Radar (PAR) similar to an FAA Terminal Radar Approach Control (TRACON).

Rare/protected species. A species that, although not presently threatened with extinction, is in such small numbers throughout its range that it may be endangered if its environment worsens.

Resource Conservation and Recovery Act (RCRA). Public Law 98-616 establishes standards and procedures for handling, storing, treating, and disposing of hazardous waste. Specifically, RCRA prohibits the placement of bulk or noncontainerized liquid hazardous waste or free liquids containing hazardous waste into a landfill. It also prohibits the land disposal of specified wastes and disposal of hazardous waste through underground injection within 1/4 mile of an underground source of drinking water.

Restricted Area. Airspace above a surface area of published dimensions within flight of aircraft is subject to restrictions caused by "(unusual and often invisible hazards" published in FAR 73. Area where restrictions are in force to minimize interference between friendly forces.

Runup. Maintenance testing of aircraft engines at various power settings and durations.

See and Avoid. A visual procedure wherein pilots of aircraft flying in visual meteorological conditions, regardless of the type of flight plan, are charged with the responsibility to observe the presence of other aircraft and to maneuver their aircraft as required to avoid the other aircraft (FAA, 1991b).

Sonic Boom. Sound resembling an explosion produced when shock waves form at the nose of an aircraft traveling at supersonic speed reaches the ground.

Sortie. An individual flight; it includes a departure, an approach, and possibly one or more closed patterns.

Sortie Operation. A sortie operation is the use of one airspace unit (e.g., restricted area, MOA) by one aircraft. Each time a single aircraft conducting a sortie flies in a different airspace unit, one sortie-operation is counted. Sortie operation applies to aircraft using the NRC airspace.

Special Use Airspace. Airspace of defined dimensions wherein activities must be confined because of their nature, and/or wherein limitations may be imposed upon aircraft operations that are not a part of those activities.

State Historic Preservation Officer (SHPO). The official within each state, authorized by the state at the request of the Secretary of the Interior, to act as liaison for purposes of implementing the NHPA.

Subsonic. Noise airframe or engine noise produced by aircraft traveling slower than the speed of sound.

Sulfur dioxide (SO_2). A toxic gas that is produced when fossil fuels, such as coal and oil, are burned. SO_2 is the main pollutant involved in the formation of acid rain. SO_2 also can irritate the upper respiratory tract and cause lung damage. See Criteria Pollutants.

Supersonic. Traveling at a speed greater than the speed of sound.

Supersonic Corridor. Designated airspace used for aircraft flight test and training activities at speeds, greater than the speed of sound.

Terminal Radar Approach Control. A terminal air traffic control facility that uses radar and nonradar capabilities to provide approach control services to aircraft arriving, departing, or transiting airspace controlled by the facility.

Threatened species. Plant and wildlife species likely to become endangered in the foreseeable future.

TRACON. Terminal Radar Approach Control. An FAA-operated control facility used for control of aircraft in a terminal area.

Troposphere. Portion of the atmosphere which is below the stratosphere, which extends outward about 7 to 10 miles from the earth's surface, and in which generally temperature decreases rapidly with altitude, clouds from, and convection is active.

U.S. Environmental Protection Agency (EPA). The independent federal agency, established in 1970, that regulates federal environmental matters and oversees the implementation of federal environmental laws.

Visual flight rules. Rules that govern the procedures for conducting flight under visual conditions.

Volatile organic compound (VOC). Compounds containing carbon, excluding CO, CO_2, carbonic acid, metallic carbides, metallic carbonates, and ammonium carbonate.

Water resources. Includes underground and surface sources of water for the area, and the quality of that water.

Wetlands. Areas that are inundated or saturated with surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil. This classification includes swamps, marshes, bogs, and similar areas. Jurisdictional wetlands are those wetlands that meet the hydrophytic vegetation, hydric soils, and wetland hydrology criteria under normal circumstances (or meet the special circumstances as described in the U.S. Army Corps of Engineers, 1987, wetland delineation manual where one or more of these criteria may be absent and area a subset of the "Waters of the United States").

Zoning. The division of a municipality (or country) into districts for the purpose of regulating land use, types of building, required yards, necessary off-street parking, and other prerequisites to development. Zones are generally shown on a map and the text of the zoning ordinance specifies requirements for each zoning category.

ACRONYMS/ABBREVIATIONS

AFB	Air Force Base
AFFTC	Air Force Flight Test Center
AFI	Air Force Instruction
AFOSH	Air Force Occupational Safety and Health
AFOTEC	Air Force Operational Test and Evaluation Center
AGE	aerospace ground equipment
AGL	above ground level
AICUZ	Air Installation Compatible Use Zone
AIM	air intercept missile
APE	area of potential effect
ATC	air traffic control
ATCAA	Air Traffic Control Assigned Airspace
ATF	Advanced Tactical Fighter
AWACS	Airborne Warning and Control System
BLM	Bureau of Land Management
CAA	Clean Air Act
CAAQS	California Ambient Air Quality Standards
CARB	California Air Resources Board
CCAPCD	Clark County Air Pollution Control District
CCR	California Code of Regulations
CDNL	C-weighted day-night level
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CNEL	community noise equivalent level
CO	carbon monoxide
Council	Advisory Council on Historic Preservation
CTF	Combined Test Force
CWA	Clean Water Act
°	degree
dB	decibel
dBA	decibels A-weighted
Dem/Val	Demonstration/Validation
DNL	day-night average sound level
DNWR	Desert National Wildlife Range
DOD	Department of Defense
DOE	Department of Energy
DT&E	Developmental Test and Evaluation
EA	environmental assessment
EIAP	environmental impact analysis process
EIS	Environmental Impact Statement
EMC	Eglin Military Complex
EMD	Engineering and Manufacturing Development
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
F	Fahrenheit
FONSI	Finding of No Significant Impact

FOT&E	Follow-on Operational Test and Evaluation
FSD	Full-Scale Development
HASC	High-Altitude Supersonic Corridor
HAZMART	hazardous materials pharmacy
HCFC	hydrochlorofluorocarbon
HDSC	Hazardous Materials Distribution Support Center
HUD	Housing and Urban Development
IOT&E	Initial Operational Test and Evaluation
JPPB	Joint Policy and Planing Board
KCAPCD	Kern County Air Pollution Control District
LFT&E	Live Fire Test and Evaluation
LTO	landing and takeoff
$\mu g/m^3$	micrograms per cubic meter
MDAB	Mojave Desert Air Basin
MIL	military
Mm	millimeter
MOA	Military Operations Area
‘	minute
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NAFR	Nellis Air Force Range
NASA	National Aeronautics and Space Administration
NATCF	Nellis Range Complex Air Traffic Control Facility
National Register	National Register of Historic Places
NAWCAD	Naval Air Warfare Center Air Division
NAWCPNS	Naval Air Warfare Center Weapons Division
NDEP	Nevada Division of Environmental Protection
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NLR	noise level reduction
nm	nautical miles
NO_2	nitrogen dioxide
NOTAM	Notice to Airmen
NO_x	nitrogen oxides
NRC	Nellis Range Complex
NWR	National Wildlife Refuge
OT&E	Operational Test and Evaluation
PAO	polyalphaolefin
PM_{10}	particulate matter equal to or less than 10 microns in diameter
POL	petroleum, oil, and lubricants
POV	privately owned vehicle
ppm	parts per million
PSD	Prevention of Significant Deterioration
psf	pounds per square foot
RCRA	Resource Conservation and Recovery Act
ROI	region of influence
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SO_2	sulfur dioxide
SO_x	sulfur oxides
sq	square
TRACON	Terminal Radar Approach Control

1	U.S.C.	U.S. Code
2	USFWS	U.S. Fish and Wildlife Service
3	VOC	volatile organic compound
4	WMA	Wildlife Management Area

APPENDIX B
SPECIAL USE AIRSPACE

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Special Use Airspace

Special use airspace consists of airspace of defined dimensions identified by an area on the surface of the Earth wherein activities (1) must be confined because of their nature, or (2) wherein limitations are imposed upon aircraft operations that are not part of those activities, or (3) both. The vertical limits of special use airspace are measured by designated altitude floors and ceilings expressed as flight levels (FL) or as feet above mean sea level (MSL). Unless otherwise specified, the word "to" an altitude or FL means "to and including" that altitude or FL. The horizontal limits of special use airspace are measured by boundaries described by geographic coordinates or other appropriate references that clearly define their perimeter. The period of time during which a designation of special use airspace is in effect is stated in the designation. Except for Controlled Firing Areas, special use airspace areas are depicted on aeronautical charts.

Special use airspace is defined as consisting of Prohibited Areas, Restricted Areas, Warning Areas, Military Operations Areas (MOAs), Alert Areas, National Security Areas (NSAs), and Controlled Firing Areas (CFAs). Prohibited and Restricted areas are regulatory, special use airspace and are established in Federal Aviation Regulation (FAR) Part 73. Warning Areas, MOAs, Alert Areas, NSAs, and CFAs are nonregulatory, special use airspace. Special use airspace descriptions (except NSAs and CFAs) are contained in the Federal Aviation Administration (FAA) Order 7400.8.

Special use airspace (except CFAs) is charted on instrument flight rules (IFR) or visual charts that include the hours of operation, altitudes, and the controlling agency. F-22 IOT&E testing is proposed for special use airspace under the control of both Edwards Air Force Base (AFB) and Nellis AFB. At low level (below 14,500 feet above MSL), this airspace consists of both Restricted Areas and MOAs.

Restricted Areas

Restricted Areas contain airspace identified by an area on the surface of the Earth within which the flight of aircraft, while not wholly prohibited, is subject to restrictions. Activities within these areas must be confined because of their nature or limitations imposed upon aircraft operations that are not a part of those activities or both. Restricted Areas denote the existence of unusual, often invisible, hazards to aircraft such as artillery firing, aerial gunnery, or guided missiles. Penetration of Restricted Areas without authorization from the using or controlling agency may be extremely hazardous to the aircraft and its occupants. Restricted Areas are published in the Federal Register and are established in FAR Part 73.

Air Traffic Control (ATC) facilities apply the following procedures when aircraft are operating on an IFR clearance via a route that lies within joint-use restricted airspace. If the restricted area is not active and has been released to the controlling agency (FAA), the ATC facility will allow the aircraft to operate in the restricted airspace without issuing specific clearance for it to do so. If the restricted area is active and has not been released to the controlling agency (FAA), the ATC facility will issue a clearance to ensure that aircraft avoid the restricted airspace, unless it is on an approved altitude reservation mission or has obtained its own permission to operate in the airspace and so informs the controlling facility. The previously mentioned procedures apply only to joint-use restricted airspace and not to prohibited and nonjoint-use airspace. For the latter categories, the ATC facility will issue a clearance so the aircraft will avoid the restricted airspace unless it is on an approved altitude reservation mission or has obtained its own permission to operate in the airspace and so informs the controlling facility.

Restricted airspace is depicted on the En Route Chart appropriate for use at the altitude or FL being flown. For joint-use restricted areas, the name of the controlling agency is shown on these charts. For all prohibited areas and nonjoint-use restricted areas, unless otherwise requested by the using agency, the phrase “NO A/G” is shown.

Military Operations Areas

MOAs consist of airspace of defined vertical and lateral limits established for the purpose of separating certain military training activities from IFR traffic. Whenever an MOA is being used, nonparticipating IFR traffic may be cleared through an MOA, if IFR separation can be provided by ATC. Otherwise, ATC will reroute or restrict nonparticipating IFR traffic.

Most training activities necessitate acrobatic or abrupt flight maneuvers. Military pilots conducting flight in Department of Defense aircraft within a designated and active MOA are exempted from the provisions of FAR Part 91.303, paragraphs c and d, which prohibit acrobatic flight within federal airways and Class B, C, D, and E surface areas.

APPENDIX C
SOUND AND SONIC BOOMS

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SOUND AND SONIC BOOMS

Sound

Sound is a propagating pressure disturbance (P) in air superimposed on atmospheric pressure. These fluctuations in pressure are perceived as sound by the ear. Noise is generally defined as sound that is undesirable because it (1) is intense enough to damage hearing; (2) interferes with speech communication and sleep; or (3) it is annoying. Sound can vary simultaneously in level (or loudness) and frequency content (pitch), while also varying in time of occurrence and duration.

The fundamental measure of sound level is the ratio between the squared sound pressure and a squared reference pressure (P^2/P_o^2). This ratio is expressed in units of decibels (dB) using a logarithmic scale. This logarithmic scale is used because it reflects the way people perceive changes in sound level. A-1 dB change in sound level corresponds approximately to the smallest change that is perceptible by humans. The logarithmic scale also compresses the enormous range of pressure amplitudes perceived by people to a smaller and more manageable set of values. Common sounds vary in amplitude over a range of many millions. For instance, an aircraft fly-over may produce a pressure amplitude 100 times greater than a car driving by on a nearby street. On the logarithmic scale, these noise sources would differ by 40 dB.

The frequency of a sound corresponds to the rate of pressure fluctuations, expressed in units of cycles per second (hertz [Hz]). The frequency content of the sound is one way humans distinguish between sounds. The human voice produces sounds mostly in the 100 to 1,000 Hz range. Musical instruments produce a wide range of frequencies. The piano produces frequencies from approximately 27 Hz to 4,186 Hz with middle "C" at 261 Hz. Other instruments usually have smaller frequency ranges. The bass tuba produces frequencies of sound from 40 Hz up to near 400 Hz, whereas the piccolo can produce sounds beginning around 500 Hz and up to over 4,000 Hz.

The frequency range of hearing varies slightly by individual and is influenced by such things as age, illness history, and exposure to high levels of sounds. The range of human hearing typically begins around 10 to 20 Hz and extends up to between 10,000 and 20,000 Hz. People do not hear equally well at all frequencies. For example, a very low-pitched sound produced by a tuning fork vibrating 50 times per second (50 Hz) must have a sound pressure level 30 dB (32 times) higher than a tuning fork vibrating at 1,000 times per second (1,000 Hz) to be perceived as having the same loudness. This is because people are less sensitive to low frequency sounds than to mid-frequency sounds. A frequency weighting system, designated as "A-weighting" (American National Standards Institute S1.4, 1983), is often used to approximate the unequal sensitivity of people to different frequencies. The A-weighting system gives less weight to low (and very high) frequencies that people do not hear well and more weight to mid-frequencies that people do hear well. This expresses the magnitude of sounds in terms relevant to people's hearing.

Sounds also vary in duration. Some sources produce virtually continuous sound levels (e.g., highway traffic), while others produce intermittent levels (e.g., aircraft flyovers). Further, some sounds change rapidly in amplitude, while others hardly change at all.

The U.S. Environmental Protection Agency (EPA) has adopted four noise descriptors as metrics to define the varying nature of environmental noises. These descriptors can then be used to predict noise effects on people and on their health. The first descriptor, and the basis from which the other three are derived, is

general A-weighted sound level (AL). AL is used to determine the amplitude of both continuous and intermittent sounds in a way that corresponds to human hearing. The AL is the instantaneous level of the sound and varies with the changing level of the sound environment.

The last three descriptors were developed to account for the variability of level, rate of occurrence, and time of occurrence of noise. They account for both the duration of the A-weighted sound and measure of the exposure to sound. These descriptors are sound exposure level (SEL), equivalent sound level (L_{eq}), and day-night average sound level (DNL).

SEL considers both the AL and duration of noise. SEL is 10 times the logarithm of the time integral, over an event, of the squared A-weighted sound pressure, relative to the square of a reference pressure of 20 millipascals (mPa) and a duration of 1 second. Use of SEL allows direct comparison between sounds with varying levels and durations by converting them to exposure levels.

The U.S. EPA's third descriptor of environmental sound is the L_{eq}. Again it is derived from ALs. Equivalent sound level is 10 times the logarithm of the time-averaged, A-weighted, mean square sound pressure over a specified time interval relative to the square of a standard reference pressure of 20 m1Pa. L_{eq} represents the mean square "average" sound level of all sounds occurring over any desired duration. For any desired time period, the single L_{eq} level has the same sound energy as the time-varying sound, AL. The descriptor takes into account all variations in sound energy within the measurement period. L_{eq} represents what would happen if the peaks and valleys of the time history were smoothed out to a single continuous sound level. That is, the time-averaged sound pressure throughout the time period is equivalent to a constant sound.

The U.S. EPA's fourth descriptor, DNL (written symbolically as L_{dn}), is used to measure the cumulative daily noise exposure of the community. DNL was developed to evaluate the total community noise environment as it varies throughout the daytime and nighttime hours. DNL is the time-averaged level of all ALs within the 24-hour period, with a 10-dB penalty adjustment added to the nighttime (2200 to 0700) levels to account for an assumed increase in sensitivity to nighttime noise. It is the policy of federal agencies such as the Federal Aviation Administration (FAA), Department of Defense (DOD), Department of Housing and Urban Development (HUD), and U.S. EPA to assess long-term, cumulative exposure to environmental noises, including aircraft, traffic, and rail noise, in terms of DNL. The Federal Interagency Committee on Urban Noise has developed land use compatibility guidelines for noise. Table 3-9 in Section 3.4.2 provides these recommended DNL ranges for various land use categories based on this committee's findings. DNL values of 65 and less are normally compatible with residential land uses.

Sonic Booms

When an object travels faster than the speed of sound in the surrounding air, the air in front of the object is compressed abruptly, forming a shock wave. This shock wave is a sudden increase in pressure, followed by a gradual decrease to below ambient pressure, then a sudden return to ambient atmospheric pressure. This pressure signature is sometimes described as an N-wave (other shapes can occur due to influences by the atmosphere or by interference effects of multiple N-waves). Aircraft within the Earth's atmosphere typically produce two shock waves as they travel at supersonic speeds; one at the nose and one at the tail. These N-waves produced by the vehicle can propagate to the ground where they are perceived as a "boom." If the two shock waves are separated by more than approximately 100 milliseconds, a double boom may be heard. When describing the magnitude of a sonic boom, it is conventional to use only the incremental increase in pressure (in terms of pounds per square foot [psf]) over ambient atmospheric pressure (approximately 2,116 psf at sea level). This quantity is termed "overpressure" and is denoted as

P. Factors that affect the nature and extent of sonic boom overpressures include aircraft design, aircraft operation, and atmospheric effects.
Aircraft design features that affect sonic boom formation include aircraft size, weight, and shape. The magnitude of the overpressure increases with the size and weight of the aircraft, while the duration of the sonic boom depends on the length of the aircraft.

Features of aircraft operations that influence the magnitude of sonic booms include altitude, Mach number (M), acceleration, and mode of flight. In general, for a given M, the lower the altitude of the supersonic flight, the greater the amplitude at any point on the ground. Increases in speed and acceleration may also increase the intensity of the boom. Aircraft flying supersonically in straight and level flight can produce a finite swath extending on both sides of the ground track where booms may be heard. These booms are called "carpet booms." Typical overpressures of carpet booms generated by military aircraft while cruising at high altitudes are on the order of 1.0 to 2.0 psf at the ground. The typical overpressures experienced during space shuttle landings over Southern California have been below 2 psf.

Pressure waves are generated when an object exceeds the speed of sound and thus are generated for all supersonic flights. However, these pressure waves do not always propagate to the ground where they are perceived as sonic booms. The propagation of the sonic boom through the atmosphere is subject to the well-known phenomenon of refraction (bending) due to temperature and wind speed gradients in the atmosphere. For certain combinations of Mach number, flight profile, and altitude, a boom may be generated, but conditions are such that the boom is refracted up and away before it reaches the ground surface. When the boom does reach the surface directly below the aircraft, there is a predictable lateral distance off the flight track of the aircraft where the refraction effects have diverted the boom upwards and the boom does not reach the ground. This distance is called the "cut-off."

An N-wave-shaped sonic boom has a spectral content (relationship of sound level and frequency) with a low-frequency fundamental component that is related inversely to the length of the aircraft. The fundamental component is accompanied by a series of harmonic components that decrease in amplitude by 6 dB for each doubling of frequency. The fundamental frequency is in the range of a few Hz up to 10 Hz for vehicles ranging in size from a space shuttle to a small fighter airplane. Although humans do not hear the very low frequencies very well, they do feel vibration from these low frequencies and can particularly hear sounds produced by vibration induced within buildings.

While most noises are satisfactorily described by AL, the predominantly low-frequency nature of high-intensity impulsive sounds produced by sonic booms and explosions create greater sensation levels for humans than AL would normally indicate.

DOD has followed the recommendations of the National Research Council - Committee on Hearing, Bioacoustics and Biomechanics Assembly in describing high-intensity, impulsive sounds such as sonic booms and explosions in terms of C-weighted sound exposure level (CSEL). Impacts on the community noise environment due to a series of these events is quantified with the C-weighted day-night level. In contrast with A-weighting that suppresses low frequencies similarly to the response of human hearing, C-weighting allows more of the low-frequency energy in a sound signal to be measured.

Many studies have been conducted of effects of sonic booms on conventional (i.e., modern, inhabited) structures. The most common incidence of damage is to glass, plaster, and bric-a-brac, as summarized in Table 3-10 in Section 3.4.2.

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APPENDIX D

AIR EMISSIONS CALCULATIONS

APPENDIX D

AIR EMISSIONS CALCULATIONS

This appendix contains details of the calculations performed to estimate emissions associated with (1) engine test runs, (2) landing/takeoff (LTO) cycle, (3) airspace flight, (4) aerospace ground equipment (AGE), and (5) mobile sources associated with the F22 IOT&E program. Except for airspace flight, emissions from each of these sources are estimated for operations that are expected to occur at Edwards Air Force Base only. Airspace flight emissions are estimated for both the R-2508 Complex and the Nellis Range Complex airspaces. All aircraft-related emissions were calculated using engine emission factors specific to the various power settings, as shown in Table D-1. Table D-2 provides details on the engine test run calculations, Table D-3 shows LTO cycle emissions, and Tables D-4 and D-5 provide airspace flight emissions. AGE emissions were estimated based on LTO cycle emission factors, as shown in Table D-6. The AGE emission estimates are contained in Table D-7; mobile source emissions are provided in Table D-8.

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Table D-1. F-22 Engine Emission Factors[a]

Engine Type	Power Setting	Emission Factors Per Engine (lb/hr)				
		CO	VOC	NO_x	SO_x	PM
F119	Idle	96.00	48.00	1.32	1.20	0.02
	Approach	62.00	22.56	27.07	5.64	0.11
	Intermed	93.50	32.73	102.85	9.35	2.57
	Military	133.60	50.10	384.10	16.70	5.77
	AB[b]	3,831.00	813.00	254.60	23.00	57.50

Notes: (a) Source: Table E-1 in "U.S. Air Force Air Conformity Applicability Model, Version 2.0 LT", U.S. Air Force 1996.

(b) Afterburner emission factors are derived from F-22 Acceptance Testing Environmental Assessment, U.S. Air Force, 1999.

AB = afterburner
CO = carbon monoxide
lb/hr = pound
NO_x = nitrogen oxides
PM = particulate matter
SO_x = sulfur oxides
VOC = volatile organic compound

Table D-2. Emissions from F-22 Engine Test Runs at Edwards AFB[(a)]

Type of Test	Power Setting	No. of Engines	Number of Engine Test Runs	Hours Per Power Setting	Emissions (lbs) CO	VOC	NO_x	SO_x	PM
Idle Leak Check	Idle	2	144	0.083	2,294.8	1,147.4	31.6	1.0	0.5
80% Leak Check	Intermed	2	144	0.006	161.6	56.6	177.7	0.6	4.4
	Idle	2	144	0.333	9,206.8	4,603.4	126.6	3.8	1.9
Military Power Runs	Idle	2	48	0.333	3,068.9	1,534.5	42.2	1.3	0.6
	Military	2	48	0.083	1,064.5	399.2	3,060.5	4.8	46.0
	AB	2	48	0.083	30,525.4	6,478.0	2,028.6	183.3	458.2
BLDG. 1899	**Total (lbs)**				**46,322.0**	**14,219.1**	**5,467.2**	**194.8**	**511.6**
	Total (tons)				**23.16**	**7.11**	**2.73**	**0.09**	**0.26**
Idle Leak Check	Idle	2	48	0.83	764.90	382.50	10.50	0.30	0.20
Military Power Run	Idle	2	48	0.333	4,270.9	1,601.6	12,278.9	19.2	184.5
	Military	2	48	0.083	1,064.5	399.2	3,060.5	4.8	46
	AB	2	48	0.083	30,525.4	6478.0	2,028.6	183.3	458.2
BLDG. 1735	**Total (lbs)**				**36,625.7**	**8,861.3**	**17,378.5**	**207.6**	**688.9**
	Total (tons)				**18.31**	**4.43**	**8.69**	**0.10**	**0.34**
All Engine Test Runs	**TOTAL (tons)**				**41.47**	**11.54**	**11.42**	**0.19**	**0.60**

Notes: (a) Type, number, and duration of engine test runs provided by the Air Force.
AB = afterburner
CO = carbon monoxide
lbs = pounds
NOx = nitrogen oxides
PM = particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Table D-3. Emissions from F-22 LTOs at Edwards AFB

Procedure	Power Setting[a]	No. of Engines	No. of LTOs[b]	Hours Per LTO[c]	Emissions (lbs) CO	VOC	NO_x	SO_x	PM
Taxi/Idle	Idle	2	740	0.496	70,471.7	35,235.8	969.0	29.4	14.7
Approach	Intermed	2	740	0.058	8,026.0	2,809.5	8,828.6	29.2	220.6
Takeoff	Military	2	740	0.007	1,384.1	519.0	3,979.3	6.2	59.8
Climbout	Military	2	740	0.013	2,570.0	963.9	7,390.1	11.5	111.0
	Total (lbs)				**82,451.8**	**39,528.2**	**21,167.0**	**76.3**	**406.1**
	Total (tons)				**41.23**	**19.76**	**10.58**	**0.04**	**0.20**

Notes: (a) Power settings for LTO cycles obtained from Table I-2 in "Calculation Methods for Criteria Air Pollutant Emission Inventories," (Jagielski and O'Brien, 1994).
(b) F-22 LTOs provided by the Air Force.
(c) Durations for LTO cycles obtained from Table I-3 in "Calculation Methods for Criteria Air Pollutant Emission Inventories," (Jagielski and O'Brien, 1994).

CO = carbon monoxide
lbs = pounds
LTO = landing/takeoff
NOx = nitrogen oxides
PM = particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Table D-4. F-22 Airspace Emissions in Edwards Complex Airspace

Power Setting	No. of Engines	No. of Sorties[a]	Hours Per Sortie	Emissions (lbs) CO	VOC	NO_x	SO_x	PM
Military	2	156	1.53[b]	63,775.3	28,136.2	215,710.6	337.0	3,240.4
Military	2	584[c]	0.37[c]	57,034.4	21,387.9	163,973.8	256.1	2,463.2
AB	2	156	0.27[b]	322,723.4	68,487.1	21,447.5	1,937.5	4,843.8
AB	2	584[c]	0.06[c]	268,476.5	56,975.0	17,842.4	1,611.8	4,029.6
Total (lbs)				**712,009.6**	**174,986.2**	**418,973.3**	**4,142.4**	**14,577.0**
Total (tons)				**356.00**	**87.49**	**209.49**	**2.07**	**7.29**

Notes: (a) Sortie and flight hour data obtained from Table 2-1 in Chapter 2.
(b) Hours per sortie determined as an average of the total flight hours divided by the total sorties, then separated by into 85 percent at military power and 15 percent at afterburner.
(c) These sorties represent the amount of time F-22s en route to the Nellis Range Complex spend transiting through Edwards airspace, then separated by 85 percent at military power and 15 percent at afterburner.

AB = afterburner
CO = carbon monoxide
lbs = pounds
NOx = nitrogen oxides
PM = particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Table D-5. F-22 Airspace Emissions in Nellis Range Complex Airspace

Power Setting	No. of Engines	No. of Sorties[(a)]	Hours Per Sortie[(b)]	Airspace Emissions (lbs) CO	VOC	NO_x	SO_x	PM
Military	2	584	1.16	181,714.2	68,142.8	522,428.2	816.1	7,848.0
AB	2	584	0.21	16,444,184.0	3,489,721.2	1,092,845.0	98,725.2	246,813.0
Total (lbs)				**16,625,898.0**	**3,557,864.0**	**1,615,273.2**	**99,541.3**	**254,661.0**
Total (tons)				**8,312.95**	**1,778.93**	**807.64**	**49.77**	**127.33**

Notes: (a) Sortie and flight hour data obtained from the Air Force, Table 2-1 in Chapter 2.
(b) Hours per sortie determined as an average of the total flight hours divided by the total sorties, then separated by 85 percent at military power and 15 percent at afterburner. Time spent transiting through Edwards airspace has been disregarded.

AB = afterburner
CO = carbon monoxide
lbs = pounds
NOx = nitrogen oxides
PM = particulate matter
SOx = sulfur oxides
VOC = volatile organic compound

Table D-6. F-22 AGE Emission Factors[(a)]

Emission Factors (lbs/LTO)				
CO	VOC	NO_x	SO_x	PM
0.5388	0.0937	0.3456	0.0425	0.0400

Note: (a) Source: All emission factors are from Table H-1 in U.S. Air Force Air Conformity Applicability Model, Version 2.0 LT, U.S. Air Force, 1996.

AGE = aerospace ground equipment
CO = carbon monoxide
NO_x = nitrogen oxides
PM = particulate matter
SO_x = sulfur oxides
VOC = volatile organic compound

Table D-7. F-22 AGE Emissions at Edwards AFB

No. of LTOs	Emissions (lbs)				
	CO	VOC	NO_x	SO_x	PM
740	398.7	69.4	255.8	31.4	29.6
Total (lbs)	**398.7**	**69.4**	**255.8**	**31.4**	**29.6**
Total (tons)	**0.20**	**0.03**	**0.13**	**0.02**	**0.01**

CO = carbon monoxide
lbs = pounds
LTO = landing/takeoff
NO_x = nitrogen oxides
PM = particulate matter
SO_x = sulfur oxides
VOC = volatile organic compound

Table D-8. F-22 IOT&E Motor Vehicle Emissions at Edwards AFB
Page 1 of 2

A. Emission Factors:

Project Year	Speed	Grams/mile CO	VOC	NO_x	PM_{10}	SO_2
2002	25 mi/hr	17.530	1.605	1.770	12.436	0.062
	50 mi/hr	9.375	0.820	1.820	12.436	0.062

CO = carbon monoxide
mi/ph = miles per hour
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound

B. Vehicle Fleet Mix Data:

Vehicle Type (Year 2002)	
Light Duty Gasoline Vehicle	60.9%
Light Duty Gasoline Truck 1	19.3%
Light Duty Gasoline Truck 2	8.6%
Heavy Duty Gasoline Vehicle	3.1%
Light Duty Diesel Vehicle	0.2%
Light Duty Diesel Truck	0.1%
Heavy Duty Truck	7.2%
Motorcycle	0.6%
Total	100.0%

C. Vehicle Miles Traveled (VMT) related assumptions for 97 employees due to implementation of project:

1	Number of additional employees:	**97**	Employees
2	The average employee's commute distance:	**40.0**	Miles/one-way
3	Ratio of non-work trip distance and work trip distance (CEQA Handbook):	**0.55**	
4	Average non-work trip distance:	**22.2**	Miles
5	Average rate of trip generation on a weekday:	**2.1**	Trips/employee
6	Average rate of trip generation on a Saturday:	**0.2**	Trips/employee
7	Average rate of trip generation on Sundays or national holidays:	**0.4**	Trips/employee
8	The distance from project site to the closest freeway ramp (@ 25 mi/hr):	**20.0**	Miles
9	Average annual business days:	**240.0**	Days/year
10	Average Vehicle Occupancy (according to ITE Trip Generation):	**1.25**	Passenger/vehicle

D. Mobile Source Emissions:

Year	Number of Employees	Speed	Annual VMT (miles)	**Emissions, TPY** CO	VOC	NO_x	PM_{10}	SO_2
2002	97	25 mi/hr	1,041,237	20.1	1.8	2.0	14.3	0.1
		50 mi/hr	776,958	8.0	0.7	1.6	10.7	0.1
	Total		1,818,195	28.1	2.5	3.6	24.9	0.1

CO = carbon monoxide
mi/ph = miles per hour
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide
TPY = tons per year
VMT = vehicle miles traveled
VOC = volatile organic compound

Table D-8. F-22 IOT&E Motor Vehicle Emissions at Edwards AFB
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25 miles/hr

Vehicle Type	Year 2002	Total PM	Paved Dust	
Light Duty Gasoline Vehicle	60.9%	0.041	1.96	
Light Duty Gasoline Truck 1	19.3%	0.047	6.41	
Light Duty Gasoline Truck 2	8.6%	0.051	13.41	
Heavy Duty Gasoline Vehicle	3.1%	0.129	44.43	
Light Duty Diesel Vehicle	0.2%	0.203	1.96	
Light Duty Diesel Truck	0.1%	0.223	7.3	
Heavy Duty Truck	7.2%	0.662	102.85	
Motorcycle	0.6%	0.041	0.5	
Total	100.0%	0.090671	12.345041	12.43571

50 miles/hr

Vehicle Type	Year 2002	Total PM	Paved Dust	
Light Duty Gasoline Vehicle	60.9%	0.041	1.96	
Light Duty Gasoline Truck 1	19.3%	0.048	6.41	
Light Duty Gasoline Truck 2	8.6%	0.052	13.41	
Heavy Duty Gasoline Vehicle	3.1%	0.129	44.43	
Light Duty Diesel Vehicle	0.2%	0.203	1.96	
Light Duty Diesel Truck	0.1%	0.223	7.3	
Heavy Duty Truck	7.2%	0.662	102.85	
Motorcycle	0.6%	0.041	0.5	
Total	99.4%	0.09095	12.345041	12.43599

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APPENDIX E

PLANT COMMUNITY DESCRIPTIONS

APPENDIX E

PLANT COMMUNITY DESCRIPTIONS

This appendix provides a description of the plant communities that are present within the R-2508 Complex and High-Altitude Supersonic Corridor (HASC) in California and Nevada, and the Nellis Range Complex (NRC) in Nevada and Utah.

Certain species occur in virtually every natural habitat. Many of the common and widespread plant species are associated with the habitats described below. However, some invasive plants such as Russian thistle *(Salsola tragus),* red brome *(Bromus matritensis* ssp. *rubens),* tansy mustard *(Descurainia pinnata),* and split grass *(Schismus barbatus)* are common in disturbed portions of natural habitats. Other exotic species have become established in more natural areas, such as tamarisk or salt-cedar (*Tamarix* spp.).

R-2508 Complex and High-Altitude Supersonic Corridor

Plant community types found within the R-2508 Complex and HASC include Mojave Desert, coniferous forests, alpine/subalpine, foothill grassland, foothill woodland, and scrub. These are described in the following paragraphs.

Mojave Desert Plant Communities. Mojave Desert plant communities include creosote bush scrub, Joshua tree woodland, arid-phase saltbush scrub, halophytic-phase saltbush scrub, lake beds, and mesquite woodlands. These communities contain species that are adapted to the xeric environments of the Mojave Desert.

Creosote bush scrub is dominated by creosote bush *(Larrea tridentata)* and supports relatively high plant diversity. Common associated plant species include burrobush *(Ambrosia dumosa),* winterfat *(Krascheninnikovia lanata),* cheesebush *(Hymenoclea salsola),* and Nevada tea *(Ephedra nevadensis).*

Joshua tree woodlands essentially occur within a variety of habitats, but are especially common in creosote bush scrub. The dominant species are the same as the “host” community, with the addition of Joshua tree *(Yucca brevifolia)*. Joshua trees provide vertical structure to the habitat, which offers additional foraging and denning/nesting opportunities for wildlife. The understory supports a high diversity of animal species including the native desert dandelion *(Malacothrix glabrata),* pincushion *(Chaenactis* spp.), and fiddleneck *(Amsinckia tesselata).*

Arid-phase saltbush scrub is found in the most arid areas, and is dominated by allscale *(Atriplex polycarpa).* Burrobush, goldenhead *(Acamptopappus sphaerocephalus),* and cheesebush are common associates of this community. Other species that may be found in this vegetation type include Nevada tea, desert alyssum *(Lepidium fremontii),* cheesebush, goldenhead, wolfberry *(Lycium andersonii),* spiny hop-sage *(Grayia spinosa),* and bud sage *(Artemisia spinescens).*

Halophytic-phase saltbush scrub occurs in narrow bands along dry lakebeds and in claypan and dune complexes. This habitat occurs in high-pH soils, and is dominated by plant species adapted to tolerate these conditions. Common plant species of halophytic-phase saltbush scrub include shadscale *(Atriplex confertifolia),* alkali goldenbush *(Isocoma acradenia* ssp. *acradenia),* and rubber rabbitbush *(Chrysothamnus nauseosus*). The understory is composed primarily of kochia (*Kochia californica*), wild rye *(Elymus cinereus*), saltgrass (*Distichlis spicata*), goldfields (*Lasthenia californica*), and alkali pineappleweed (*Chamomilla occidentalis*).

Although essentially devoid of vegetation (except at the edges), lakebeds and other ephemeral bodies of water are an important environment for wildlife. Composed of clayey soils, this habitat type includes playas, claypans, and lakebeds. These features vary in size and morphology, and support a unique fauna adapted to seasonal inundation and desiccation. Birds, especially wading birds and waterfowl, are attracted to these areas during winter and spring migrations when inundation takes place.

Mesquite woodlands, a relatively spatially restricted habitat on Edwards Air Force Base (AFB) and the Mojave Desert, occur on more mesic washes and drainages. As with Joshua tree woodlands, the dominant species in mesquite woodlands are mesquite (*Prosopsis glandulosa*), with an understory comprising dominants found in the "host" plant community. Mesquite woodlands also provide vertical structure to the habitat, which is important to wildlife.

Coniferous Forest Plant Communities. Several coniferous forest types occur in the Sierra Nevada Range including red fir forest, yellow pine forest, mixed coniferous forest, and pinyon-juniper woodlands.

Red fir forests are dominated by red fir (*Abies magnifica*), Jeffrey pine (*Pinus jeffreyi*), western white pine (*Pinus monticola*), lodgepole pine (*Pinus murrayama*), snow bush (*Ceanothus cordulatus*), bush chinquapin (*Chrysolepis sempervirens*), and quaking aspen (*Populus tremuloides*). Red fir forests are found at high elevations, between 8,000 and 9,000 feet.

Yellow pine forests are dominated by ponderosa pine (*Pinus ponderosa*), sugar pine (*Pinus lambertiana*), white fir (*Abies concolor*), big-cone spruce (*Pseudotsuga macrocarpa*), black oak (*Quercus kellogii*), and various shrub species. Yellow pine forests occur at mid-elevations, between 5,000 and 8,000 feet.

Mixed conifer forests have variable species composition, but occur between the upper limits of yellow pine and the lower limits of red fir forests.

Pinyon-juniper woodlands occur between 5,000- and 8,000-foot elevations on drier mountain slopes. They comprise sparse stands of single-leaf pinyon pine (*Pinus monophylla*) and various juniper species (*Juniperus* spp.). Shrubs and perennial bunch grasses are often interspersed between the sparse stands of the dominant pinyon and juniper trees.

Alpine/Subalpine Plant Communities. Alpine/subalpine plant communities include subalpine forests and alpine habitats.

Subalpine forests are dominated by high-elevation pines such as white bark pine (*Pinus albicaulis*), foxtail pine (*Pinus balfouriana*), limber pine *(Pinus flexilis*), lodgepole pine, mountain hemlock (*Tsuga mertensiana*), and various shrub species. Generally a comparatively low-growing and sparse woodland community, subalpine forest is limited to a few scattered localities above elevations of 9,500 feet.

Alpine habitats, also referred to as fell fields, occur at the uppermost vegetated elevations. Alpine habitats are generally dominated by a variety of low-growing herbaceous species such as sedge (*Carex* spp.) and draba (*Draba* spp.), with astragalus (*Astragalus* spp.), Indian paintbrush (*Castilleja* spp.), and penstemon (*Penstemon* spp.) comprising the common wildflowers. Fescues (*Vulpia* spp.) and bluegrasses (*Poa* spp.) are common grasses found within alpine habitats.

Foothill Grassland Plant Communities. Foothill grasslands, also known as Valley grasslands, are dominated by various grass species. This low-growing, herbaceous community is limited to the lower elevations of the western Sierra Nevada Range and the San Joaquin Valley. Prior to European settlement and widespread cultivation and urbanization of the San Joaquin Valley, the species composition of these grasslands primarily consisted of native annual and bunch grasses. Currently, native grass populations are sparsely distributed among what are predominantly non-native annual species such as brome grasses (*Bromus* spp.), oats (*Avena* spp.), barley (*Hordeum* spp.), split grass (*Schismus barbatus*), filaree (*Erodium* spp.), and mustard (*Hirschfeldia incana* and *Brassica* spp.). Natives include annual flower species such as goldfields (*Lasthenia* sp.), gilia (*Gilia* spp.), California poppy (*Eschscholtzia californica*), phacelia (*Phacelia* spp.), owl's clover (*Orthocarpus* spp.), and Indian paintbrush, and native grasses of various genera (e.g., *Achnatherum* spp. and *Poa* spp.).

Foothill Woodland Plant Communities. Foothill woodlands are dominated by oaks at lower elevations and certain pines at their upper elevations on the western side of the Sierra Nevada Range. A grassland understory is characteristic of this community. Oak species found in this habitat include coast live oak (*Quercus agrifolia*), canyon oak (*Quercus chrysolepis*), blue oak (*Quercus douglasii*), interior live oak (*Quercus wislizenii*), and valley oak (*Quercus lobata*). California bay (*Umbellaria californica*), currant (*Ribes* spp.), ceanothus (*Ceanothus* spp.), and buckthorn (*Rhamnus* spp.) are other foothill woodland component species.

Scrub Plant Communities. Various nondesert scrub communities are also common in this area. Scrub communities include shadscale scrub dominated by shadscale; chaparral dominated by chamise (*Adenostoma fasciculatum*), buckwheat (*Eriogonum fasciculatum*), toyon (*Heteromeles arbutifolia*), manzanita (*Arctostaphylos* spp.), and ceanothus (*Ceanothus* spp.); and sage-grass (also known as sagebrush grassland) dominated by Great Basin sagebrush (*Artemisia tridentata*), blackbrush (*Coleogyne ramosissima*), rabbitbrush (*Chrysothamnus* spp.), and antelopebush (*Purshia glandulosa*).

Nellis Range Complex

Plant communities found in the NRC include the same Mojave Desert plant communities as described for the R-2508 Complex/HASC. Additional plant communities found within the NRC include shadscale scrub, blackbrush scrub, and greasewood scrub; sage-grass including

sagebrush scrub and galleta-blue grama scrub-steppe, pinyon-juniper, and montane. These are described in the following paragraphs.

Shadscale scrub and blackbrush scrub are similar communities that form an elevation zone between creosote bush scrub of the Mojave Desert and sagebrush scrub. Blackbrush scrub is more common in the southern part of the NRC. Dominant species are either shadscale or blackbrush. Associated species include four-winged saltbush (*Atriplex canescens)*, spiny hop-sage, spiny sagebrush (*Artemisia spinescens*), winter fat, and Nevada tea.
Greasewood scrub is another vegetation community of low elevations on the northern part of the NRC. It is dominated by greasewood (*Sarcobatus vermiculatus*) and occurs especially in alkaline soils. Co-dominants found within this habitat include winter fat and green molly (*Kochie americana*).

Sagebrush scrub occurs at lower elevations and is dominated by Great Basin sagebrush. Rabbitbrushes and joint-fir (*Ephedra viridis*) are common associates within this habitat. Joshua tree and juniper (*Juniperus osteosperma*) are occasionally found here, as well. The grass community closely associated with sagebrush scrub is galleta-blue grama scrub-steppe, which includes the dominant grass species if little galleta grass (*Hilaria jamesii*) and blue grama (*Bouteloua gracilis*).

Pinyon-juniper woodlands are present at higher elevations on NRC where increased precipitation and cooler temperatures prevail. Dominant components of this habitat are single-leaf pinyon pine and junipers. This habitat also supports an assemblage of species including snowberry *(Lymphoricarpas longiflorus*), black sagebrush (*Artemisia nova*), joint-fir, and rabbitbrushes.

Montane vegetation occurs at elevations above 8,000 feet. The primary component of this community is white fir associated with single-leaf pinyon and limber pine.